FINAL
ENVIRONMENTAL IMPACT STATEMENT
ON HURRICANE PROTECTION
AND BEACH EROSION CONTROL
FOR

DARE COUNTY BEACHES, NORTH CAROLINA
(Bodie Island Portion)

FINAL
FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT ON HURRICANE PROTECTION AND BEACH EROSION CONTROL FOR DARE COUNTY BEACHES, NORTH CAROLINA (Bodie Island Portion)

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FINAL ENVIRONMENTAL IMPACT STATEMENT

Dare County Beaches
Beach Erosion Control and Hurricane Wave Protection
Dare County, North Carolina

The responsible lead agency is the U.S. Army Engineer District, Wilmington

ABSTRACT: The Dare County Beaches study was authorized by a House Resolution adopted August 1, 1990. The Wilmington District has investigated public concerns in the study area regarding damage reduction from storm waves and flooding, and control of beach erosion. Alternatives investigated were nonstructural measures, dunes and/or berms of various dimensions and no-action. Significant resources that occur in the study area include Socioeconomic Resources, Marine Resources, Terrestrial Resources, Threatened and Endangered Species, Recreation and Aesthetic Resources, Cultural Resources and Section 122, P.L. 91-611 Resources. After consideration of the environmental consequences of all alternatives the proposed plan is to construct the alternative that has the greatest net National Economic Development (NED) benefits or the NED Plan. This plan consists of a vegetated dune with a crest elevation of 13 feet above National Geodetic Vertical Datum (NGVD) and a berm approximately 50 feet wide at 7 feet NGVD. Project construction will include two project segments North and South. The North segment includes Kitty Hawk and Kill Devil Hills and covers about 4.1miles of shoreline. The South segment provides protection to Nags Head and covers 10.1 miles of beach. An approximate 3,000-foot transition is included on both ends of each segment. The proposed source of beach fill for project construction and maintenance is located in two offshore borrow sites covering an area of about 7 square miles, located approximately 1 to 2 miles offshore in the Atlantic Ocean. The potential impacts associated with beach nourishment within the study area are primarily from the excavation of fill material and from the placement of this material on the beach. Construction of this plan is considered to be economically and environmentally feasible.

SEND YOUR COMMENTS TO THE DISTRICT ENGINEER BY THE DATE INDICATED ON THE REPORT TRANSMITTAL LETTER.

If you would like further information on this statement, please contact:

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1.00 SUMMARY

1.01 Major Conclusions and Findings

The Wilmington District has investigated opportunities to reduce damage from hurricanes and storm events and beach erosion (Figure 1-1). Alternatives include non-structural measures, dunes and/or berms of various dimensions, and no-action. The "no action" plan does not reduce storm damage or erosion damage and therefore does not address the planning objectives. Any NED benefits that may have been provided by the proposed plan would be foregone under a no action plan. Impacts to environmental resources caused by on-going local activities to protect ocean front property including beach scraping, sandbag and beach disposal would be expected to continue. Non-structural measures, including relocation, selective retreat, and evacuation, do not address property losses caused by erosion. Given the presence of many large structures along the oceanfront that are physically impractical to move, lack of adequate space for relocating the structures, and high cost of relocation, this alternative was not found economically feasible for federal participation.

Significant resources which occur in the study area include Socioeconomic Resources, Marine Resources, Terrestrial Resources, Threatened and Endangered Species, Recreation and Aesthetic Resources, Cultural Resources and other significant resources as identified by Section 122 of P.L. 91-611. These resources, and their occurrence in the study area, are described below. After consideration of the costs, benefits and environmental consequences of the proposed and alternative actions, the Corps of Engineers proposes to construct the alternative plan that has the greatest net National Economic Development (NED) benefits or the NED Plan. This plan consists of the initial construction and periodic nourishment of a vegetated dune with a crest elevation of 13 feet National Geodetic Vertical Datum (NGVD) and a berm 50 feet wide at 7 feet NGVD. The project will include two project segments a North Project Area and a South Project Area. The North Project Area (Kitty Hawk and Kill Devil Hills) covers about 4 miles of shoreline. The South Project Area (Nags Head) covers about 10 miles of beach. An approximate 3,000-foot transition is included on both ends of each segment. The proposed source of sand for initial construction and periodic nourishment is two borrow sites (covering an area of about 7 square miles) located 1 to 2 miles offshore in the Atlantic Ocean.

The potential impacts associated with beach nourishment within the study area are primarily from the excavation of fill material and the placement of this material on the beach. Impacts will be reduced by use of beach compatible sandy material and avoidance of borrow sites that contain hardbottom or significant cultural resources. Due to the large scope of this project, it is proposed that initial project construction would be conducted without seasonal restrictions. This would reduce the total construction period by allowing construction during optimum production periods when the wave climate is reduced. Fewer mobilizations would reduce associated

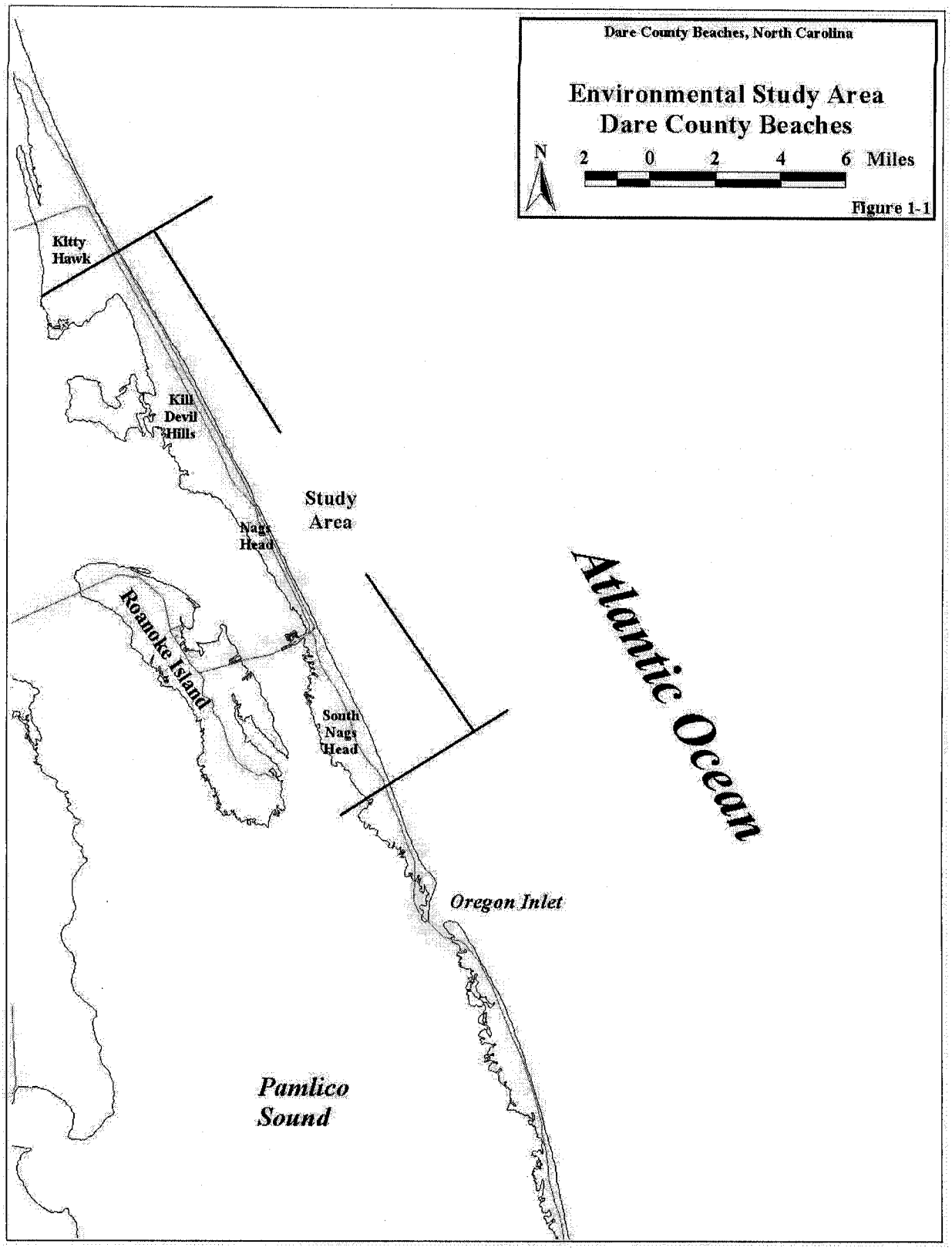


Figure 1-1 Study Area Map

costs. Project maintenance will occur to the degree practical during the fall and winter to reduce impacts to beach and surf zone fauna and recreation. Construction of this plan is considered to be economically and environmentally feasible.

1.02 Areas of Controversy or Significant Concern

(This section has been revised since publication of the DEIS)

Agencies and individuals commenting on the Draft EIS provided many substantial and pertinent comments. A copy of the letters and correspondence received on the Draft Environmental Impact Statement for the Hurricane Protection and Beach Erosion Control, Dare County Beaches and the Corps response to each comment are included in Attachment C. The following issues are considered areas of particular concern expressed in comments received regarding impacts of the proposed project or the adequacy of the DEIS.

- Public Policy on Federal Involvement in Beach Nourishment.
- Validation of GRANDUC Model
- Evaluation of Non-structural Alternatives
- Cumulative Impacts Analysis
- Monitoring Needs and Timing of Project Initiation
- Sand Compatibility in N1 Borrow Area
- Impacts of Turbidity and Dredging on Important Fisheries
- Consideration of Barrier Island Transmigration and Sea Level Rise
- Impacts of Sediment Transport to Oregon Inlet

1.02.1 Public Policy on Federal Involvement in Beach Nourishment

There is much general discussion in the comments of the US Fish and Wildlife Service (as well as the conservation groups) about the preference for undeveloped versus developed beaches and the recognition that in an unaltered condition, shorelines move and adjust to wave and wind action. While we understand the preference for undeveloped beaches, we point out that protecting and restoring the shores of the United States is Congressionally authorized and directed. Specifically, the Corps of Engineers is directed to provide assistance in reducing damages to shorefront development and coastal resources from shore erosion and storm events. Thus the argument is with public law and national policy as reflected in Congressional directives. Nevertheless, there is clear intent by Congress to provide protection for both undeveloped beaches and developed beaches

1.02.2 Validation of GRANDUC Model

The GRANDUC model was subjected to an intensive review by the Corps of Engineers Institute of Water Resources (IWR), Alexandria, Virginia and a consultant from RMM Technical Services, Cincinnati, Ohio. The reviewer from IWR is a

recognized expert in the field of risk and uncertainty whereas the RMM Technical Services consultant is an expert in computer programming.

The reviewers evaluated the model for its technical soundness, programming accuracy, and the degree to which risk and uncertainty was represented. The reviewers made both short-term and long-term recommendations for improvement of the model. Most of the short-term recommendations were aimed at correcting some computational glitches and minor programming problems in the code such as: using the mid-year discounting rather than beginning of the year, using double-precision coding throughout the program, using a different random number generator for the sub-program STORM9, assuring that the base year of the project is properly defined, and providing additional detailed output on individual damage components. All of these suggested changes were incorporated into the model prior to its final application to the Dare County Beaches project.

For the long-term, the reviewers suggested that the model be reconstituted by employing up-to-date programming techniques and incorporating storm response computations directly in the model rather than external to the model as is the present case. The basic code for the model was written in 1995, and actually consists of a series of individual programs that are externally linked. For example, there are presently separate codes for the without project case and the with project case. The results of these two are compared and summarized by a third program. Future versions of the model should also include uncertainty distributions for several program parameters that are currently treated as deterministic. Overall, the model was judged to represent a sound first step toward the development of a risk and uncertainty model for coastal projects and many of the aspects of the model would be adopted in the revised code. Until the code undergoes these major revisions, the reviewers concluded that GRANDUC was the best model currently available and satisfied the basic intent to provide some measure of the risk of failure associated with the adoption of a particular plan.

In addition to the technical review of the inner workings of the model, the model has been reviewed for its adherence to Corps of Engineers planning policies by representatives of the South Atlantic Division (CESAD) and Headquarters (HQUSACE). This review generated questions of whether or not the model satisfies the risk-based requirements cited in ER 1105-2-100, the reasonableness of the damages computed by the model, the relationship between storm recession and damage to structures, and the number of life cycle simulations used. All of these concerns were addressed to the satisfaction of CESAD and HQUSACE representatives during an April 27-28, 2000 held in SAD offices in Atlanta.

Finally, the Wilmington District made a comparative analysis of the output of GRANDUC to the output produced by a former model known as COSTDAM. COSTDAM was the plan formulation model used prior to GRANDUC and was basically a damage potential model in which the shoreline was eroded in yearly increments and the potential for storm damage to individual structures based on the

probability of storms of varying frequency impacting the structure during each year. Damages attributable to a particular storm during each year of the analysis were discounted based on the probability of that storm. The damages in the out-years of the analysis were brought back to present worth using compound interest. The comparative analysis between the results of the COSTDAM model and GRANDUC indicated that the average damages produced by the GRANDUC model were less than the damages predicted by COSTDAM. Accordingly, GRANDUC was shown to produce results consistent with this previously accepted coastal plan formulation model.

Following the review, the models were modified in accordance with the recommendations provided by the IWR. In addition to the technical review of the models, the model outputs were evaluated by Corps Headquarters and South Atlantic Division personnel. The two models were judged to provide reasonable and consistent comparisons of the damages to be expected in the area and the damage reduction potential associated with various plan alternatives. The overall process use to develop the recommended plan was found to be in accordance with the Federal standards published in "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, U.S. Water Resources Council, March 10, 1983.

1.02.3 Evaluation of Non-structural Alternatives

Comments by the National Marine Fisheries Service, US Fish & Wildlife Service, National Park Service, Sierra Club, and the Southern Environmental Law Center indicated their position that non-structural alternatives were not sufficiently evaluated in the DEIS. Additional discussion on this subject has been added to the FEIS at Section 3.00 ALTERNATIVES. Potential non-structural measures that were considered include (1) retrofitting existing buildings, (2) stricter zoning and setback requirements and building codes for new buildings (3) selective retreat, (4) relocation, and (5) evacuation. Although each was determined not to offer a reasonable alternative for the problems identified for the Dare County beaches, we believe that the additional information provided in the FEIS adequately addresses this topic.

1.02.4 Cumulative Impacts Analysis

Comments by the National Marine Fisheries Service, US Fish & Wildlife Service, National Park Service, Sierra Club, and the Southern Environmental Law Center and others indicated their position that cumulative impacts were not sufficiently evaluated in the DEIS. Additional discussion on this subject has been added to the FEIS at Section 6.01.02. The revised assessment of cumulative impacts addresses dredging effects at ocean borrow sites and beach placement of dredged sand for the proposed project. The magnitude of the proposed action is discussed in relation to projected similar activities, which may occur over the vicinity and the North Carolina coastal area in the future.

1.02.5 Monitoring Needs and Timing of Project Initiation

The project area provides high quality habitat (wintering and spawning ground) for commercially important fishes. Agencies are concerned regarding the long term effects of beach disposal (including the placement of construction material during the summer months) and ocean dredging on commercially important fish species, due to turbidity, habitat alteration and reduced benthic food. Beach invertebrates also provide food for shore birds. The high quality of the sediment selected for excavation and beach fill, the small length of beach affected at any point in time, the wide distribution of these species in relation to the area of habitat affected, and expected rapid recovery of the benthic resources would not suggest that the proposed project, poses a significant threat. However, due to the importance of the marine and other resources on the area, we believe that monitoring is appropriate to demonstrate reasonable indication of expected recovery of benthic food sources in the borrow area and to identify any unforeseen significant impacts to larval, juvenile and adult fish, and shorebirds in the borrow and beach placement area.

The Corps will address these issues through the development of an integrated pre- and post-construction monitoring plan. This plan will be developed during 2001 through coordination with known interested agencies or institutions, and monitoring should be implemented in 2002. This will be two years prior to project construction scheduled for 2004. The plan will consider results from ongoing monitoring studies as described below to identify reasonable and prudent investigations that will establish baseline conditions, and assess construction, short term, and long term impacts on habitat and/or indicator species.

Except for an offshore borrow area not being involved, a similar integrated monitoring plan for beach disposal actions on several beaches in Brunswick County, North Carolina is currently being coordinated and should be implemented in early 2001. Information gathered from this coordination and monitoring effort will be helpful in the development of the monitoring plan for this project. It is expected that pertinent data from the Brunswick County study will be available prior to construction of the proposed project, which is not scheduled to begin until 2004.

1.02.6 Sand Compatibility in N1 Borrow Area

A Sand Compatibility Analysis (Native Beach Sand Versus Borrow Sand) has been conducted. This analysis included samples of native beach and the potential borrow areas. The search for suitable borrow material for construction and periodic nourishment was conducted in two phases. Phase I consisted of the collection of over 535 miles of seismic sub-bottom profiles. Phase II involved the collection of 208 vibracores. Grain size analyses were conducted on sediment samples collected from the vibracores and were used to delineate potential borrow areas. The grain size characteristics of the sediments were used to develop weighted composite grain size distribution representative of all of the sediment in each borrow area. The weighting was based on the grain size distribution and thickness of a particular

sample. A weighted grain size distribution was computed for the entire core. The weighted core distributions were used to compute the overall composite characteristics for the entire borrow areas. The analysis included an estimate of the amount of fine-grained sediments in each core.

As part of the process to determine borrow sites, additional borings will be drilled in the previously identified borrow areas prior to the beginning of the nourishment project. If these borings show material that is not suitable for use as beach fill, then they can be eliminated for use as borrow at that time. All material which is not suitable for beach fill will be avoided. There is no guarantee when performing a subsurface investigation that all material between borings will be consistent due to the spacing of the borings. If during dredging, areas are identified that have too much material unsuitable for beach fill, they can be skipped over by the dredging operation. Previous contract specifications have addressed this, and there are directions to the contractor on how to proceed when this occurs.

When material is removed from a borrow area and placed on a receiving beach, the deposited sediment will be sorted by wave action. If the beach fill material contains all of the same grain sizes that exist on the native beach, the beach fill will be redistributed by waves and currents to an quasi-equilibrium position of the beach profile. The coarser grained material will remain on the foreshore while the finer fractions will move to the deeper portions of the profile.

One estimate of the suitability of borrow material for placement on the beach is based on the overfill factor. The overfill factor is an indication of the volume of borrow material required to produce one net cubic yard of sorted beach fill material. The overfill factor is computed by numerically comparing the size distribution characteristics of the native beach sand with that in the borrow area and includes an adjustment for the percentage of fines in the borrow area. The overfill factor is based primarily on the assumption that the borrow material will undergo sorting and winnowing once exposed to waves and currents in the littoral zone, resulting in a sorted distribution approaching that of the native sand. The numerical procedure for computing an overfill factor is contained in a suite of computer programs contained in the Automated Coastal Engineering System (ACES) produced by the U.S. Army Coastal Engineering Research Center.

The overfill factor for borrow area N1 is 1.5. This overfill factor is influenced by the difference in the composite mean grain sizes of the borrow material (N1 is 0.22 mm) versus the native beach material (north project beach is 0.31 mm). The mean grain size for the north project beach is 0.31 mm.

1.02.7 Impacts of Turbidity and Dredging on Important Fisheries

Comments by the National Marine Fisheries Service indicated their position that the DEIS underestimated dredging impacts at borrow site N1 because many sediment samples from that site contain greater than 10 percent fines (silt and clay), which could result in higher levels of suspended sediments and turbidity than stated. Concerns were expressed that such conditions at borrow site N1 would be detrimental to over-wintering populations of striped bass, Atlantic sturgeon, and weakfish, as well as other important fish species. Also noted as an area of controversy was the potential impact of beach nourishment on early life history stages of fishery resources.

The discussion of turbidity impacts in the beach fill placement area has been expanded in the EIS section 6.00 and attachment C which is the DEIS comments and responses.

The available data indicates that the spatial scales of elevated turbidity associated with beach fill activities are relatively small. The impacts from turbidity generated from beach fill activities are not expected to be significant. While the project area includes approximately 14 miles of beach, the beach fill placement will take place only at one or two locations at any one time.

The discharge of dredged material on the beach will increase nearshore zone turbidities. The turbidity in the plumes is expected to be similar in magnitude to conditions encountered during storm events. However, the spatial extent of elevated turbidities associated with beach fill will be relatively small. Van Dolah et al. (1994) determined the spatial extent of turbidity plume associated with a beach nourishment at Folly Beach, South Carolina. They found that the turbidity plume as determined by measurements of NTUs extended approximately 1,000 m in a down longshore current direction at a distance of 15 m from shore and 500 m at a distance of 30 m from shore. Turbidity levels were variable depending on local weather conditions. During periods of calm winds and seas, turbidities of about 100 NTUs were measured at the discharge. Measurements of a beach fill action in New Jersey revealed similar results (USACE New York District 1999).

1.02.8 Consideration Barrier Island Transmigration and Sea Level Rise

Comparative analysis of barrier island changes dating from the mid 1800's to the mid 1940's do not support the often quoted barrier island rollover concept. The Wilmington District compared detailed maps of the barrier islands from Rodanthe south to Beaufort Inlet as well as Masonboro Island, located along the southern portion of the North Carolina coast. The comparative analysis determined changes in the ocean shoreline position, changes in the sound shoreline position, and changes in the marsh vegetation line over the approximately 75 year period. Note that the marsh vegetation line is the line that separates the upland areas of the barrier islands from the soundside marsh. This particular time period was selected for analysis as it did not include significant affects of the artificial dune building program on the islands that began in the mid to late

1930's. The general findings of this analysis are reported in the Phase II General Design Memorandum for the Manteo (Shallowbag) Bay project (also known as the Oregon Inlet project) as well as in Shore and Beach (publication of the American Beach Preservation Association). The study found that the barrier islands are experiencing general erosion on both the ocean and sound sides. Also, the marsh vegetation line generally moved seaward. These measured changes were deemed to be consistent with changes one would expect as a result of a 0.75 to 1.0 foot rise in sea level during the analysis period. The only area exhibiting classic barrier island retreat characteristics was the east end of Ocracoke Island which "rolled over" in response to a sediment deficit created by the opening of Hatteras Inlet in 1846. The general findings of the Wilmington District study were verified by subsequent work of Everts, Battley, and Gibson in a report entitled "Shoreline Movement" which was published as a Coastal Engineering Research Center Technical Report TR CERC-83-1. Everts, et al also found that the islands from Virginia Beach south to Cape Hatteras were eroding on both the ocean and sound side. Based on the findings of these studies, barrier island migration is not a significant factor in the management of the barrier islands over the next 50 to 100 years.

1.02.9 Impacts of Sediment Transport to Oregon Inlet

Sediment transport to the south toward Oregon Inlet is predicted to increase linearly from zero in the first few years following construction of the storm damage reduction project to around 13 percent at the end of the 50-year project life. Of the increased volume of sediment transported to the inlet, only a relatively small percentage is expected to actually shoal the channel. For example, the existing navigation channel captures approximately 25 percent of the gross littoral drift moving toward the inlet. Note that gross drift is the sum of material moving along the shoreline in both the north and south directions. Assuming that the additional sand arriving at the inlet from the nourishment project shoals the channel by the same percentage, shoaling of the Oregon Inlet navigation channel would only increase by a maximum of 3 to 4 percent by the end of the 50-year project life. However, shoaling would be much less than this during the majority of the 50-year period. Generally, shoaling increases of this magnitude are not discernible as the volume lies within the error ban associated with the survey data. Accordingly, the Dare County project would not have a measurable impact on shoaling of the Oregon Inlet ocean bar channel.

1.03 Unresolved Issues

There are no unresolved issues known at this time.

1.04 Relationship of Plan to Environmental Requirements

The relationship of the proposed project to environmental protection statutes and other environmental requirements is presented in Table 1-1. Compliance with all applicable Federal, State, and local policies has been examined.

1.05 USFWS Coordination

The U.S. Fish and Wildlife Service has prepared a comprehensive draft Fish and Wildlife Coordination Act Report on the proposed project, which offers their views on potential project impacts on significant fish and wildlife resources in the project area. Their draft report is included in Appendix B – Draft Coordination Act Report, USFWS. The reader is encouraged to read their report. Corps responses to USFWS Conservation Recommendations are included in section 8.02 of this report. Responses have been finalized based on review of comments on the DEIS.

TABLE 1-1: Relationship of the Proposed Project to Environmental Requirements

Federal Laws and Policies	Proposed Action
Abandoned Shipwreck Act of 1987	Full Compliance
Clean Water Act of 1977, as amended	Full Compliance
Clean Air Act, as amended	Full Compliance
Coastal Zone Management Act of 1972, as amended	Full Compliance
Coastal Barrier Resources Act of 1982	Full Compliance
Endangered Species Act of 1973, as amended	Full Compliance
Estuary Protection Act of 1968	Full Compliance
Federal Water Project Recreation Act of 1968, as amended	Full Compliance
Fish and Wildlife Coordination Act of 1934, as amended	Full Compliance
Fishery Conservation and Management Act of 1976	Full Compliance
Hazardous and Toxic Materials Issues	Full Compliance
Land and Water Conservation Act of 1964, as amended	Not Applicable
Magnuson-Stevens Fishery Conservation and Management Act of 1996	Full Compliance
Marine Protection, Research, and Sanctuaries Act of 1972, as amended	Full Compliance
Marine Mammal Protection Act of 1972, as amended	Full Compliance
Migratory Bird Treaty Act of 1918, as amended	Full Compliance
National Historic Preservation Act of 1966, as amended	Full Compliance
National Environmental Policy Act of 1969, as amended	Full Compliance
River and Harbor Act of 1970, Public Law 91-611, Section 122	Full Compliance
Submerged Lands Act of 1953, as amended	Full Compliance
Water Resources Development Act of 1986, Section 906	Full Compliance
Watershed Protection and Flood Prevention Act of 1954, as amended	Full Compliance
Wild and Scenic Rivers Act of 1968, as amended	Not Applicable
Executive Orders (EO), Memoranda, etc.	
EO 11988, Flood Plain Management	Full Compliance
EO 11990, Protection of Wetlands	Full Compliance
EO 11593, Protection and Enhancement of the Cultural Environment	Full Compliance
EO 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations	Full Compliance
CEQ Guidance on Prime and Unique Farmlands	Full Compliance
State Law and Local Policies	
Coastal Area Management Act (CAMA) of 1974	Full Compliance
Dare County Land Use Plan	Full Compliance
Kill Devil Hills Land Use Plan Update	Full Compliance
Nags Head Land Use Plan Update	Full Compliance
Kitty Hawk land use Plan Update	Full Compliance

1Note: Full compliance is defined as having met all the requirements of the statute, Executive Order, or other environmental requirement for the current stage of project planning.

2.00 NEED FOR AND OBJECTIVES OF ACTION

2.01 Study Authority

Authorization for the Dare County Beaches, North Carolina study is a House Resolution, adopted August 1, 1990.

2.02 Study Area

This report presents the results of studies conducted to address the needs for hurricane and storm damage reduction for Dare County beaches. The authorized study area includes portions of Dare County, South of Oregon Inlet, that are not the subject of this Environmental Impact Statement (EIS). Study emphasis in this EIS is placed on the 20-mile-long area requested by the local sponsor. This area includes the resort communities of Nags Head, Kill Devil Hills, and Kitty Hawk. This report is submitted in partial compliance with the resolution quoted in the "Study Authority" section of the Final Feasibility Report for Dare County Beaches (Bodie Island Portion), dated September 2000.

The Dare County Beaches (Hatteras and Ocracoke Islands Portion) study will investigate the hurricane and storm damage reduction needs for NC 12 between Oregon Inlet and Ocracoke Inlet (including Pea Island). Investigation of this area will be conducted as a separate study and reported later. NCDOT has indicated a willingness to be the non-Federal sponsor for this study. The project reported herein has independent utility, that is the Federal Government would recommend this project whether or not a Federal project is recommended for the protection of NC 12 between Oregon Inlet and Ocracoke Inlet. Also, the project recommended herein assures adequate opportunity for the consideration of alternatives, both for this project and for the later project.

2.03 Problems, Needs and Opportunities

Hurricanes and northeasters periodically strike the study area. The worst storms to have occurred recently are the Halloween Storm, a northeaster in 1991 and Hurricane Dennis in 1999. The Halloween Storm resulted in damages to over 500 buildings. Five buildings were destroyed. Hurricane Dennis destroyed 7 structures in the study area, damaged another 93 to the point of condemnation, and more than 700 others to a lesser degree. Numerous other storms have threatened the area. The 1950's and early 1960's were a period of intense storm activity that included several severe hurricanes and the Ash Wednesday Storm, a late winter northeaster that was the unquestioned storm of record until the Halloween storm. The 1970's and 1980's were relatively calm. In the past few years, hurricane activity in the Atlantic Ocean has intensified. Long term erosion rates of up to 10 feet per year are occurring in the study area. Dare County is the designated non-Federal sponsor, as well as cost-sharing partner in the feasibility study.

2.04 Environmental Concerns and Investigations

This project is of particular environmental concern due to its potential magnitude, and the sensitivity of high value resources in the project area. Recent hurricanes and concurrent proposals for Federal, state and private beach protection activities in North Carolina have focused agency and public interest on beach management issues. Significant resources found in the study area include marine resources; threatened and endangered species; terrestrial resources; human resources and cultural resources. Environmental concerns associated with the Dare County Beaches Project were investigated and documented. An EIS was deemed appropriate to address all applicable environmental laws and regulations as well as other environmental concerns associated with the project.

2.05 Public Concerns

Dare County and the towns of Kitty Hawk, Kill Devil Hills and Nags Head have indicated that they desire greater protection from the effect of hurricanes and northeasters and control of beach erosion to reduce recession of the shoreline. Three letters were received from private individuals during the scoping process that described concerns regarding the impacts of beach nourishment and requested that alternatives other than beach nourishment be investigated or that local solutions be sought, and that cost to the taxpayer be avoided or minimized.

2.06 Planning Objectives

Based on the identified public concerns and the needs and opportunities determined in the course of the planning process, the following planning objectives were established:

a. Reduce the adverse effects of hurricanes and northeasters including flooding and erosion, considering nonstructural, structural and no Federal action solutions.

b. Avoid or minimize impacts to natural resources including beach invertebrates, marine fish, sea birds and marine mammals.

c. Protect endangered and threatened species.

3.00 ALTERNATIVES

Alternatives considered for shore protection include no action, offshore breakwaters, groin fields, bulkheads, relocation, and beach nourishment. Offshore breakwaters and a hardened shoreline alternative such as groins or bulkheads were not considered because of coastal management policies that prohibit hardened structures due to their impact on adjacent beaches. "Nonstructural" measures were considered as required by Federal planning regulations. These measures include relocation, elevating, or waterproofing of buildings to reduce susceptibility to damage. A beach nourishment project would consist of (1) a beach berm project to control erosion; or (2) a beach berm and dune project to control erosion and reduce wave overwashes during storms. A no action plan, non-structural alternatives and various configurations of berm and dune were evaluated as described below. Alternative borrow sources were evaluated as part of the berm and dune plans. A no action plan, non-structural alternatives, and various configurations of beach fills were evaluated as described below.

3.01 Without Conditions (No Action)

The most likely without project condition for the Dare County beaches is basically a "no action" plan. Under a no-action alternative, there would be no federal participation in hurricane and storm damage reduction for the project area. A "no action" plan does not preclude the kind of temporary or emergency measures, such as beach scraping and sandbagging, that individual owners have been undertaking to save their property. These emergency measures are ineffective at battling the receding shoreline over the long term. This analysis assumes that any emergency measures that would take place to save ocean front properties under the without project condition would simply not be enough to protect the oceanfront structures from being destroyed and, thus, would be the equivalent of a "no action" plan.

The "no action" plan does not address the planning objectives and therefore any NED benefits that may have been provided by the proposed plan would be foregone. If no action is taken, erosion, wave action and flooding could claim more than 1,000 structures over the next 50 years. This would amount to losses of about 20 percent of the combined Kitty Hawk, Kill Devil Hills, and Nags Head present tax base. No Federal action would not preclude impacts to environmental resources since on-going local activities to protect ocean front property including, beach scraping, sandbagging, beach disposal and associated impacts would be expected to continue.

3.02 Nonstructural Alternatives

Potential non-structural measures that were considered include: (1) retrofitting existing buildings, (2) stricter zoning and setback requirements and building codes for new buildings, (3) selective retreat, (4) relocation, and (5) evacuation. Each of these measures can be beneficial in reducing some types of damages, but none

address the issue of the loss of land, including the existing beach, caused by long-term erosion. Retrofitting existing buildings may allow some structures to withstand some levels of storm and erosion forces. However, no amount of retrofitting will protect many of the structures in the study area against erosion and storm damage anticipated to occur over the next fifty years. Stricter zoning requirements and setbacks, as well as stronger building codes, could minimize storm and erosion damages to structures that have not yet been built, but would not address damages to existing structures.

Retreat refers to the movement of a structure further back on its existing lot. Relocation is the movement of a structure to another parcel of property. Evacuation involves a buy-out program. As long-term erosion approaches a structure, it may undergo retreat or relocation to safer ground if sufficient time, funding, and an acceptable alternate site are available, or, alternatively, the structure could be purchased with public funds, demolished, and subsequently removed. Retreat does not provide a long-term solution to erosion damages within the study area because many of the threatened structures are on lots of insufficient size to allow retreat. There are relatively few lots where this option could be applied (mostly in South Nags Head). Most of these properties have already had their homes moved back from the ocean. The projected rates of erosion in the study area indicate that entire lots as well as roads are at risk, so there is simply inadequate space for structural retreat.

Relocation of oceanfront structures, even assuming there were available lots to accept these structures and associated infrastructure, would be unreasonably expensive. It is estimated that if it were possible to relocate all the oceanfront structures along the same boundaries as the recommended project, it would cost about $300 million. The $300 million estimate is based on cost estimates of moving 1,085 oceanfront homes and 63 oceanfront motels and large condominiums that would be protected by the recommended beach nourishment project. Information provided by several house moving companies estimated that the cost of disconnecting an average oceanfront house from its pilings and utilities, moving it to a nearby vacant lot, and reconnecting it to its new pile foundation would be about $60,000. Purchase of a new lot at about $40,000 would bring the total to $100,000 per home. Recognition of the difficulties associated with moving the motels and large condominiums plus the expense of acquiring suitable new sites in an area of scarcity resulted in average estimated cost of $1.2 million each to relocate these 63 structures to a new lot. Increasing this cost of about $184 million ((1,085 X $100,000) + (63 X $1.2 million)) by 20% each for contingencies, engineering and design, and construction management would add another $110 million. This estimated cost does not include interest during construction or the costs of removing infrastructure, such as roads and utility lines. Expected annual costs for this relocation alternative, based on the one-time expenditure of $300 million at an interest rate of 6-5/8 percent, is more than $20 million.

Evacuation or buy-out of the same oceanfront structures would be even more expensive with an estimated cost of $400 million. This alternative would involve the same 1,085 oceanfront homes and 63 oceanfront motels and large condominiums cited above. This assumes an average cost of $353,333 each based on the unit cost reported in the Heinz Center's April 2000 *Evaluation of Erosion Hazards*, a study prepared for the Federal Emergency Management Agency (Dare County was one of the counties included in the study). The $353,333 is derived from the report's total buy-out cost of $530 million for the 1,500 structures evaluated and includes structure and land value. This cost is also assumed to be sufficient to include demolition, contingencies, interest during construction, engineering, and construction management. Expected annual costs for this evacuation plan based on the one-time expenditure of $400 million at an interest rate of 6-5/8 percent is about $28 million.

Present Federal guidelines on relocation plans allow claiming benefits only for: (1) the value for the new use of the vacated land; (2) reducing damage to public property, such as roads and utilities; (3) reducing emergency costs; (4) reducing administrative costs of disaster relief; and (5) reducing the flood insurance subsidy. In a permanent relocation plan, no benefit is allowed for reducing private flood damage because it is assumed that expected flood losses are reflected in the lower property values that would be paid to buy the structure. Therefore, it would be double-counting to also consider the costs of the physical damages. The sum of the categories of allowable benefits for a relocation or an evacuation plan for the oceanfront structures within the recommended project limits would not come close to justifying the cost of such a plan. The value for the new use of the vacated land as based on the value of public access in the area is estimated at $150 million ($2,000 per linear foot X 14.2 miles), or $10,357,000 in expected annual value. Reducing damage to public property, emergency costs, and costs of disaster relief is estimated at $450 ($516,000 / 1,148 structures) annually. Finally, reducing the flood insurance subsidy is estimated at $167,600 ($146 X 1,148 structures). Therefore, total expected benefits of these non-structural plans would be about $10.5 million, and the benefit-to-cost ratio for the relocation and evacuation plans would be about 0.5 and 0.4, respectively.

In addition, a serious difficulty with the concept of relocation is that the existing number of developable vacant lots within the study area is inadequate to support the relocation of the number of structures threatened. New land would have to cleared and readied for development. The $300 million estimate does not include any costs for the environmental consequences of developing new infrastructure and suitable lots for these relocated structures. The impacts of such new developments would place additional pressure on the remaining natural resources of the barrier island.

Non-structural plans like a systematic retreat or relocation of oceanfront structures based on their vulnerability to long-term erosion also leave many structures in harms way when hurricanes and northeasters strike. An unprotected structure that might

be due to be moved back as long-term erosion approaches could be destroyed by a single storm event.

Non-structural plans also tend to be unacceptable to local communities, and because costs exceed benefits, these are not plans that the Corps of Engineers could pursue. We are unaware of any entity; Federal, State or local, which would coordinate, fund, and implement such a plan. Although the town of Nags Head was once an advocate of oceanfront retreat as its chief means of dealing with erosion, the town now favors beach nourishment as its preferred approach. The towns of Kill Devil Hills and Kitty Hawk, as well as Dare County, all consider beach nourishment as the preferred alternative for addressing ocean erosion impacts. Most officials of Dare County and its municipalities do not believe that relocation or evacuation are practical solutions to address the problems of beach erosion and storm damage, or preserving their communities.

The non-structural alternatives that were evaluated for the Dare County beach communities are not economically feasible. Further, they do not fully address the problem of long-term beach erosion and storm damage. The relocation alternative is impractical due to a lack of available real estate for relocation, as well as the environmental consequences of clearing and developing the scarce remaining undeveloped property on the barrier island. The evacuation alternative is even more expensive than the relocation plan. Finally, all the non-structural alternatives lack community support, funding and means of implementation. Therefore, non-structural measures were determined not to offer a reasonable alternative for the problems identified for the Dare County beaches.

3.03 Structural Alternatives

Two types of alternative beach-fill sections were evaluated: 1) a beach berm, and 2) a dune and berm. These beach-fill sections are described below.

3.03.1 Beach Berm Plans

The berm is a fill extending seaward from the existing profile, with an elevation of 7 feet NGVD (approximately the elevation of the natural vegetation line along the Dare County Beaches). Berm width is measured seaward along the top of the berm from the point where the top of berm intersects the natural profile. Seaward of the designed berm width, the with-project profile parallels the existing profile out to the closure depth of –27 feet NGVD. The widths evaluated were 50, 100, and 150 feet. The elevation of each berm was 7 feet NGVD and each was established from a construction line tied to both the existing shoreline and the existing development.

3.03.2 Dune and Berm Plans

Existing dunes were assumed to remain in place, with the designed dunes tying into them where appropriate. Designed dune templates were tied to a construction line,

which is based on both the existing shoreline and the existing development. The landward slope of the dune template is 5 horizontal to 1 vertical, the top of the dune is 25 feet wide, and the seaward slope is 10 horizontal to 1 vertical. The berm elevation is 7 feet NGVD, with berm width measured from the toe of the constructed dune. Seaward of the designed berm width, the with-project profile parallels the existing profile out to a closure depth of –27 feet NGVD. Top of dune elevations of 13 and 15 feet NGVD were evaluated with a 50-foot berm at elevation 7 feet NGVD. A 13-foot high dune with a 25-foot berm at 7 feet NGDV was also evaluated.

The predicted impacts of these alternatives on the area's resources would be similar overall. Varying only in the degree of the impacts that would vary depending on the extent of the borrow area and near shore bottom affected and the duration of the initial construction and periodic nourishment activities. The plans are listed below in order of their expected environmental impacts based on relative sand requirements. The proposed plan is the plan that produced the maximum net economic benefits and is referred to as the National Economic Development (NED) plan.

Table 3-1. Beach-fill Plans & Material Requirements

Plan Description	Material Required (Million Cubic Yards)			Net Benefit (Million Dollars)		
	North	South	Total	North	South	Total
a) 50' berm only	**1.5**	**3.0**	**4.5**	**9.7**	**167.3**	**177.0**
b) 11' dune with a 50' berm	3.2	**5.4**	**8.6**	**14.4**	**190.5**	**204.9**
c) 100' berm only	3.0	**6.7**	**9.7**	**11.6**	**175.5**	**187.1**
d) 13' dune with a 25' berm	3.5	**6.3**	**9.8**	**14.8**	**189.3**	**204.1**
e) 13' dune with a 50' berm	***4.3***	***8.0***	***12.3***	***16.5***	***200.5***	***217.0***
f) 150' berm only	4.8	**10.4**	**15.2**	**9.6**	**175.2**	**184.8**
g) 15' dune with a 50' berm	5.6	**11.0**	**16.6**	**12.7**	**199.7**	**212.4**
h) 13' dune with a 100' berm	**5.9**	**11.7**	**17.6**	**10.0**	**187.8**	**197.8**

While plans a through d would be smaller than the proposed plan e (shown in bold italic type) and would be expected to have less overall impact, the relative environmental differences are considered minor and acceptable in order to gain the additional public benefits of the NED Plan as described in appendix H.

3.04 Alternative Borrow Sources

Central to the consideration of any beach fill alternative is the availability of environmentally acceptable borrow sites with material of sufficient quality and quantity to construct and maintain the project. Investigations for borrow material were limited to the area offshore of the area where the project is proposed. Trucking of sand from an upland source or dredging from an estuarine source were not considered reasonable or acceptable alternatives. Previous studies of potential

borrow sources for beach fill projects which concentrated on upland and sound side aquatic sources north of Oregon Inlet have indicated that material from these sources are not acceptable for beach fill. Offshore sand deposits were identified as the most likely locations of suitable beach quality sand for the project with minimal impacts on environmental and cultural resources.

3.04.1 Subsurface Investigations

The borrow area was investigated using both geophysical methods and vibracore sampling. The results of the geophysical investigations were used to plan the boring locations. Data was collected between the 30-foot and 60-foot isobaths in a long rectangular area from Oregon Inlet north to the pier at Duck. Sub-bottom methods included high-resolution seismic reflection and CHIRP sonar. These were augmented with side scan sonar and fathometer data. The geophysical survey data was groundtruthed with vibracores penetrating a maximum of 20 feet. A review of the processed seismic sections indicates a surficial seismically transparent unit, which generally exists on remnant shoal features. The material used to nourish the beach will come primarily from this unit, which is post-Pleistocene or Holocene in age.

3.04.2 Vibracore Investigations

Vibracore investigations were performed in two phases with the locations based on the data obtained from the geophysical investigations. The first phase generally identified the types of materials offshore, and the second phase defined the extent of the deposits of suitable beachfill material. Boring locations were between ½ mile and 3 nautical miles offshore, in water depths of 50 feet or less. Additional borings where located where there was a change in seismic profile, which might indicate a change in material.

3.04.3 Borrow Areas

Five potential sources of material have been identified and are discussed below. The predominate material types are clean sand (SP), slightly silty sand (SP-SM), and silty sand (SM), with minor amounts of very silty sand (SM), silt (MH and ML), and clay (CH).

(1) Area N1 This area is between 0.5 mile and 1.7 miles offshore, covers approximately 800 acres, and contains approximately 5,200,000 cy of material. About 9 percent of the material passes the #200 sieve. The bottom elevation ranges from –32 NGVD to –62 NGVD.

(2) Area N2 This area is between 0.5 mile and 1.9 miles off shore, covers approximately 330 acres, and contains 2,400,000 cy of material. About 6 percent of the material passes the #200 sieve. The bottom elevations range from –32 NGVD to –52 NGVD.

(3) Area S1 This area is between 0.9 mile and 3.5 miles off shore, covers approximately 5,700 acres, and contains 105,000,000 cy of material. About 5 percent of the material passes the #200 sieve. The bottom elevations range from –27 NGVD to –-62 NGVD.

(4) Area S2 This area is between 0.8 mile and 1.8 miles off shore, covers approximately 990 acres, and contains 7,200,000 cy of material. About 11 percent of the material passes the #200 sieve. The bottom elevations range from –42 NGVD to –62 NGVD.

(5) Area S3 This area is between 0.5 mile and 1.0 mile off shore, covers approximately 180 acres, and contains 1,400,000 cy of material. About 13 percent of the material passes the #200 sieve. The bottom elevations range from –32 NGVD to –57 NGVD.

3.04.4 Final Selection of Borrow Areas

Table 3-2 below shows the volume of material available from each of the five defined borrow areas. Based on analysis of the compatibility of the offshore borrow material with the native beach sand in the project area, the sand in the southern borrow area (S1) is of higher quality and is much more compatible with the native beach sands. Of the five defined sites only N1, N2, and S1 are compatible for beach-fill. Sites S2 and S3 in the southern area had silt contents exceeding 10 percent and were therefore excluded as a borrow source. N2 is not currently proposed as a borrow site due to its irregular shape and bottom depths; however, it may be used in the future if needed. In particular it would be used if additional beach nourishment proves feasible. Total potential borrow material for all five sites is 120,606,000 cubic yards: however, the practical usable material for this study utilizing only sites N1 and S1 is 109,646,000 cubic yards. The total beach-fill material estimated for this job during the 50-year project life is 79,040,000, which is 72 percent of the available borrow material in sites N1 and S1. More vibracore holes will be scheduled prior to preparation of the plans and specifications to fully explore the limits of borrow material.

Table 3-2. Borrow Site Volumes	
Northern Borrow Sites	**Volume (cubic yards)**
N1	5,192,000
N2	2,353,000
North Total	7,545,000
Southern Borrow Sites	**Volume (cubic yards)**
S1	104,454,000
S2	7,219,000
S3	1,388,000
South Total	113,061,000
Total Sand Investigated (N1+N2+S1+S2+S3)=120,606,000	
Total Suitable Sand* (N1+N2+S1)=216,453,000	
Sand Proposed for Use (N1 + S1) =109,646,000	

3.04.5 Sand Compatibility

A detailed description of the sand compatibility analysis is included in appendix D, Sand Compatibility. A summary is provided below. The overfill ratio is the primary indicator of the compatibility of the borrow material to the native material, with a value of "1.00" indicating 100 percent compatibility. For the Dare County study area, the composition of native beach material varies from coarser sand in the Kitty Hawk area at the north end of the study area, becoming finer heading south, and culminating as medium sand in South Nags Head at the south end of the study area. Consequently, the native beach sand composition was grouped for the two project reaches to determine compatibility with offshore borrow sources. Table 3-3 compares the native beach sand in the two project reaches to the borrow material found in both the northern and southern borrow areas.

Table 3-3. Sand Compatibility Analysis
Borrow Site Material Placed on Native Beach Material

Native Beach Materials		
Project	**Mean Grain Size** (GS mm)	**Std.Dev.** (Phi)
North Project Area	0.31	1.50
South Project Area	0.26	1.52

Borrow Materials				**Overfill Ratio**		**Corrected Ratio***		
Site	%Silt	Mean GS	Std. Dev.(Phi)	North	South	Silt	North	South
(mm)						Factor		
N1	9%	0.22	1.93	1.3	1.2	1.1	1.5	1.3
N2	6%	0.24	1.52	1.3	1.0	1.06	1.4	1.1
S1	5%	0.34	1.43	1.0	1.0	1.05	1.1	1.1
S2	11%	0.24	1.83	1.2	1.1	1.12	1.4	1.3
S3	13%	0.21	1.27	2.0	1.5	1.15	2.3	1.7

Notes:* Corrected for silt content

3.04.6 Borrow Area Use Plan

The economic optimization of the use of offshore borrow sites for the life of the project will be reevaluated when the final borrow area data has been collected and fully analyzed. Additional vibracore borings scheduled prior to developing plans and specifications will become part of the final borrow area use plan. Any additional environmental concerns will also be addressed in development of this final plan.

3.04.7 Elimination of N1 Alternative

The NMFS and USFWS have suggested that N1 is unacceptable for beach quality borrow material due to silt content greater than 10 percent, which they believe will increase turbidity. On that basis, they have requested the elimination of this site, to reduce potential turbidity impacts to important fish species including striped bass, spiny dogfish and summer flounder.

The elimination of N1 is not expected to provide a significant reduction in project impacts as described below and would substantially increase the cost of the project. The elimination of N1 as a borrow site is therefore not proposed.

Review of seasonal distribution maps from NMFS EFH source documents for spiny dogfish and summer flounder show that these species may be present in the project area, however, this data does not suggest any particular affinity to N1 over S1. While data on striped bass catch (USFWS CAR) is generally slightly higher in N1, it

is expected that this may be due to its more northerly location rather than a site preference. The surface area of N1 that is proposed for use (300 acres), is a very small portion of a much larger geographic area that is considered habitat for spiny, dogfish and summer flounder, extending from Nova Scotia to Cape Hatteras, North Carolina. Nearshore ocean waters from Cape Lookout, North Carolina to Cape Charles Virginia are the wintering grounds for the Atlantic Coast migratory striped bass population. Considering the distribution of these species, the use of N1 as a borrow site does not represent an increased threat to striped bass, spiny dogfish or summer flounder populations.

Sediment characteristics are an important factor influencing turbidity during dredging operations. Thirty-five cores were used to define the characteristics of the material in Borrow Area N1. Data for each of these cores is provided in Tables E-3A and E-3B of Appendix E in the feasibility report. Table E-3A provides data for the 6 cores taken in 1995 while Table E-3B has data for the 29 cores taken in 1998. The cores, which varied in total length from 2 feet to slightly less than 20 feet, were used to determine the depth below the surface where suitable beach quality material was located. For example, core number 430 (labeled Boring Hole #430 in Table E-3A) had a total length of 504 centimeters (cm) or 16.5 feet while only the upper 77 cm (2.5 feet) was considered to be acceptable beach quality material. Therefore, removal of material from the vicinity of core 430 would be limited to a depth of cut of 2.5 feet below the existing bottom. Accordingly, only this upper layer of material was used to determine the size characteristics of the material that would be removed from the area represented by core 430. All of the 35 cores used to define the characteristics of the material in N1 were evaluated in a similar manner, as shown in the tables. Based on this method of analysis, which properly represents the characteristics of the borrow material that would be removed and placed on the beach, only 9 of the 35 cores had percent silt contents greater than 10 percent. The useable length of four of these holes were only 4 feet or shorter. The weighting process used to determine the average size characteristics for the entire area was then based on the useable length of each core and the assumption that each core represented the same surface area of the borrow area. The Corps recognizes that there may be pockets of unsuitable material within N1 that will have to be avoided altogether in order to prevent unacceptable materials from being pumped to the shoreline. Since construction of the north project will only require the removal of 83 percent of the available volume, avoiding these unacceptable areas will not be a problem. Prior to construction, much more detailed subsurface investigations will be carried out to further identify the good and bad areas within N1. These detailed investigations will involve the taking of bore holes in a 500-foot grid pattern over the entire area. This hole spacing will provide sufficient definition of the material characteristics throughout N1 to allow us to develop a borrow area use plan that will avoid the unacceptable areas by limiting the depth of dredging in some areas, such as that represented by core number 430, or avoiding certain portions of N1 altogether. We therefore have determined that this site is suitable for the proposed use.

The major factors influencing the strength of the turbidity or sediment resuspension source at the dredge are the sediment type being dredged, the dredge plant and manner in which it is operated, and ambient currents. If the sediment is primarily sand, material may be released to the water column, but it quickly settles out. If the material is primarily fine grained, it can remain in suspension for a longer period of time while being subjected to the processes of diffusion, settling, and transport. An approach for estimating the sediment mass released by a dredge was proposed by Nakai (1978). Nakai proposed a Turbidity Generation Unit (TGU) which is dependent on the volume rate of dredging and the dredged sediment particle diameter. Hydraulic cutterhead TGU's for sand with 1.5 % silt to sandy loam with 11.4 % silt were 0.3 kg /m3 and 1.4 kg/m3, respectively. Maximum TGU values were about 45 kg /m3 for sediment which is 35% slit and clay. These data support the position that differences in dredge-induced turbidity caused by the differences in sediment characteristics between borrow area N1 and the other borrow areas will not be significant. There will be a difference in turbidity generation between a 1 percent silt and 11 percent silt, but it is relatively small., Dredging within N1 is not expected to produce turbidity levels significantly higher than those for the other borrow areas.

The cost of eliminating borrow area N1 is substantial. Because of the distance between the remaining borrow area S1 and the North project area, hopper dredging would be necessary. To calculate the additional costs of changing the borrow area for the north project from N1 to S1 in the most optimistic way, it was assumed that the entire job could be completed with only one mobilization. (In practice, additional mobilizations may be needed, at approximately $1 million each.) Initial construction costs would increase from $22.7 million to $38 million. This increase of $15.3 million is a best case estimate since actual cost would likely be higher.

The elimination of N1 is not expected to provide a significant reduction in project impacts as described below and would substantially increase the cost of the project. The elimination of N1 as a borrow site is therefore not proposed.

4.00 RECOMMENDED PLAN OF ACTION

The plan that combines a 50-foot wide berm with a dune at 13 feet NGVD, hereafter referred to as the 13/50 dune and berm, has the highest net National Economic Development NED benefits and is the NED Plan. Reaches with positive net benefits were combined to formulate two distinct project segments, each with a transition zone on both end and a distance of about three miles between them.

4.01 Project Dimensions

A proposed project map is shown on Figure 4-1. A typical construction profile is shown on Figure 7 of the Draft Feasibility Report. Initial construction will include two project segments, a North Project Area and a South Project Area. The North Project Area includes portions of the towns of Kitty Hawk and Kill Devil Hills and covers about 4.1 miles of shoreline. The South Project Area provides protection to Nags Head and covers 10.1 miles of beach. An approximate 3,000-foot transition is included on both ends of each segment. Borrow Requirements, Table 4-1 shows the initial construction volumes and 3-year renourishment volumes required for the North and South Project Areas for the NED plan (13-foot dune and a 50-foot berm). Volumes shown are borrow quantities that have been adjusted for required overfill factors.

4.02 Construction Methods

The type of dredge used will depend on many factors including competition in the market place, pumping or haul distance, depth and extent of dredging, weather conditions, and time of year. The "Outer Banks" of North Carolina is subjected to the most severe wave climate along the entire East Coast of the United States as discussed in section 5.02. Since borrow material will come from an ocean site, the potential for adverse sea conditions will be a major consideration in selection of dredging methods and equipment. The largest waves occur during winter storms with lesser wave heights during the summer months. Therefore highest production would be expected during the summer. Methods that may be used for this project are described below. Standard earth moving equipment would be used on the beach for berm and dune construction under all scenarios.

4.02.1 Hydraulic Pipeline Dredge

An ocean-certified hydraulic pipeline dredge could be used to remove material from the borrow area and pump the material directly to the beach. The dredge pipeline would run from the dredge operating in the borrow area to the beach disposal site. The pipeline would be submerged from the dredge to a point close to shore where the pipeline would then run above the surface to shore.

4.02.2 Hydraulic Pipeline Dredge with Barges and Scows

An ocean-certified pipeline dredge could be used to dredge the material from the borrow area and pump the material into barges or scows onsite for transport to the beach. The material would be transported to a pump out station offshore of the beach where the material would then be pumped from the scows to the beach.

Table 4-1. Borrow Sand Requirements
(cubic yards)

Project Area	Initial Construction Volume	Average 3-year Renourishment Volume	50-year Project Renourishment Volume	Total Project Volume
North Project	4,300,000	1,055,000	16,880,000	21,180,000
South Project	8,040,000	2,835,000	45,360,000	53,400,000
Totals	12,340,000	3,890,000	62,240,000	74,580,000

4.02.3 Hopper Dredge with Direct Pumpout

An ocean-certified hopper dredge could dredge the material from the borrow area and then transport it to a pump out station where it would be pumped from the hopper dredge to the beach.

The relative effects of the potential construction equipment on significant resources are discussed where applicable in section 6.00. While the types of equipment will not be specified, a likely plan for initial construction as described below was the basis for estimating project cost. The North Project Area would take material by pipeline dredge from borrow site N1 just offshore and the South Project Area would take material by pipeline dredge from borrow site S1 just offshore. A likely periodic nourishment plan calls for the North Project Area to take material by hopper dredge from borrow site S1 for all 16 periodic nourishment cycles and for the South Project Area to take material by pipeline dredge from borrow site S1 for all 16 periodic nourishment cycles.

Table 4-2 shows the volumes that would be removed from each borrow site for the NED plan under the aforementioned likely scenario. Borrow site N1 would provide 4,300,000 cubic yards of sand and borrow site S1 would provide 74,580,000 cubic yards. These quantities result in a 71 percent utilization of Borrow site N1 and a 72 percent utilization of borrow site S1.

Table 4-2. Borrow Site Sand Utilization
(cubic yards)

Borrow Site	Initial Construction	Renourishment (50-yr)	Total Utilized
N1	4,300,000 (NP)	----------	4,300,000
S1	8,040,000 (SP)	62,240,000(SP,16-cycles)	70,280,000
Totals	12,340,000	62,240,000	74,580,000
Note: "NP" denotes North Project and "SP" denotes South Project.			

A concept plan for site utilization, limiting use to portions of the site that have been surveyed and found clear of hardbottom and cultural resources, is shown on Figures 4-2 and 4-3. This plan indicates that enough suitable material that is free of hardbottom or significant cultural resources is available for initial construction and periodic nourishment over the 50 year project life.

4.03 Initial Construction Phases

Initial project construction and periodic nourishment segments have been divided into phases based on expected project performance requirements, economic considerations (including the financial capability of the non-Federal sponsor), and environmental impacts. Currently, the plan is to construct the project in four approximately equal phases in terms of shoreline length and volume requirements. The phases would be as follows: (1) Kitty Hawk and Kill Devil Hills, (2) Nags Head-north segment, (2) Nags Head-south segment, and (4) South Nags Head.

FIGURE 4-2. Concept Plan for North Area Borrow Site Utilization

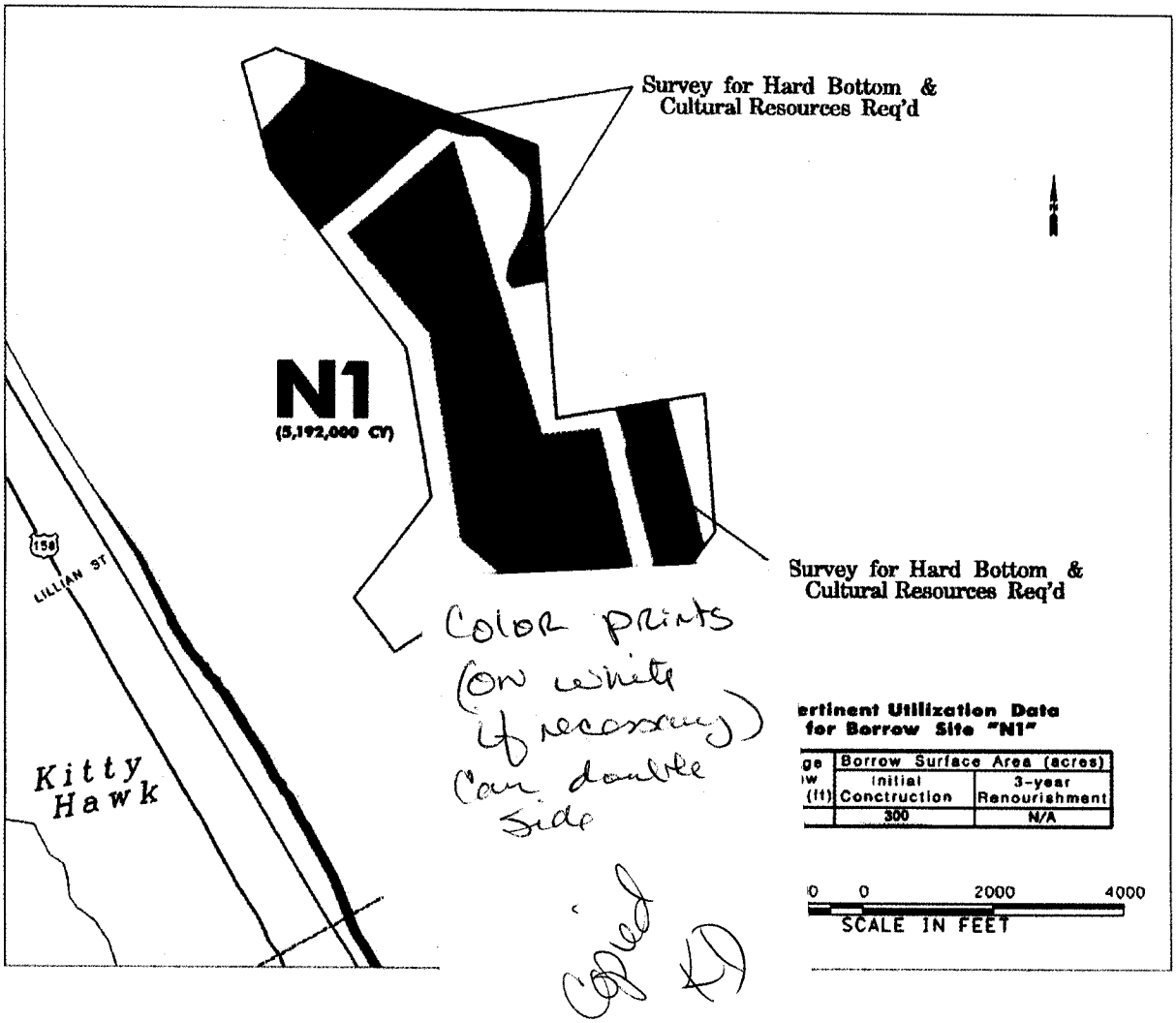
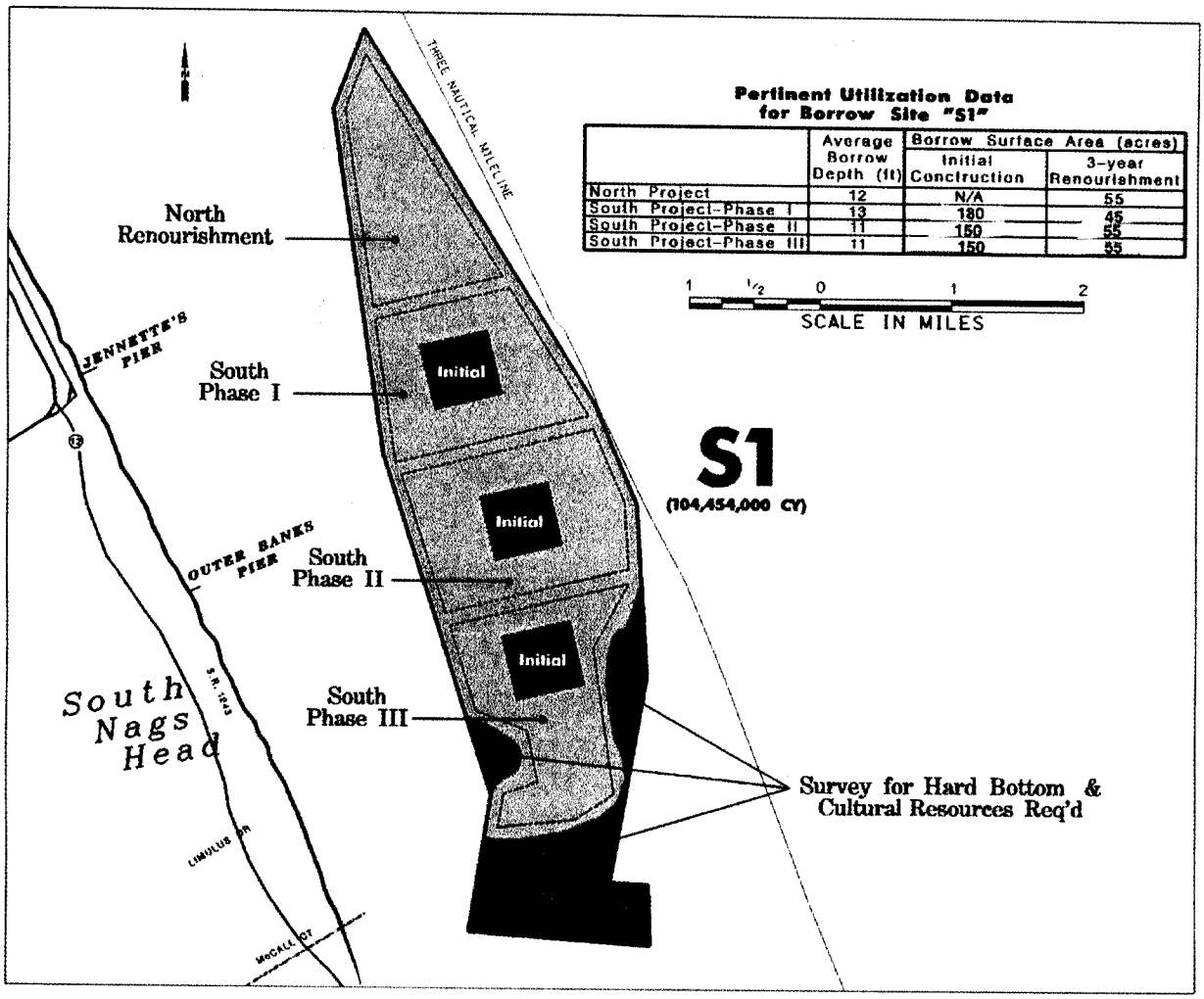


FIGURE 4-3: Concept Plan for South Area Borrow Site Utilization



4.04 Construction Schedule

There is a limited amount of dredge plant that is capable of constructing this project and it is expected that some of this dredge plant will be required for construction and maintenance of other navigation and beach projects. The Corps generally does not dictate equipment requirements in its contracts. The contractor will determine how the work will be accomplished and what pieces of equipment will be needed to satisfy contract requirements. However it is expected that at least two dredge plants working concurrently will be required for a portion of the project to complete construction within a required three-year construction period.

The proposed schedule divides the project into four segments and assumes that at least two segments will be constructed concurrently. Disposal operations will begin as a soon as practical after the previous seaturtle nesting season (ending November 15) and continue until construction of a given segment is complete (about 8 –12 months). Any subsequent segment would also begin as soon as practical after November 15 to avoid the previous sea turtle nesting season. A proposed schedule relative to expected seasonal occurrence of significant resources is shown on Figure 4-4. There is no time year when dredging and beach disposal would avoid all significant resources in the project area. While the initial construction schedule does not avoid all significant resources, the proposed phased construction and efforts to start a given phase as soon as practical after November 15 will cause much of the work to occur during colder, less biologically productive, months when less sensitive resources are present.

4.05 Periodic Nourishment Schedule

As with the existing condition, material placed on the beach is expected to be eroded from the upper profile and displaced seaward to form an offshore bar parallel to the shoreline during storm events. With the return of fair weather conditions, much of this displaced material is expected to work its way back onshore. Between periodic nourishment of the project, the towns would continue to make repairs to the beach fill following storms. This consists primarily of reshaping the fill cross-section using material displaced from the upper portions of the profile or hauled in from some outside source.

Initial construction will be followed by periodic nourishment (approximately every three years) as shown on Figure 4-4. It is proposed that this work would begin as soon as practical after 15 November and be completed prior to 1 May to the degree practical to avoid impacts to seaturtle nesting activities and minimize impacts to other beach resources. Minor extensions may be made upon approval of regulatory agencies. The proposed schedule assumes that periodic nourishment of the North Project Area would be conducted with materials excavated by Hopper Dredge under the NMFS Regional Biological Opinion (BO) for Hopper Dredging in the Corps South Atlantic Division. Our proposed schedule for hopper dredging is more restrictive than the beach disposal window (15 November to 30 April). Since the BO does not restrict hopper dredging to a specific time period, extensions that are within the 15 November to 30 April disposal

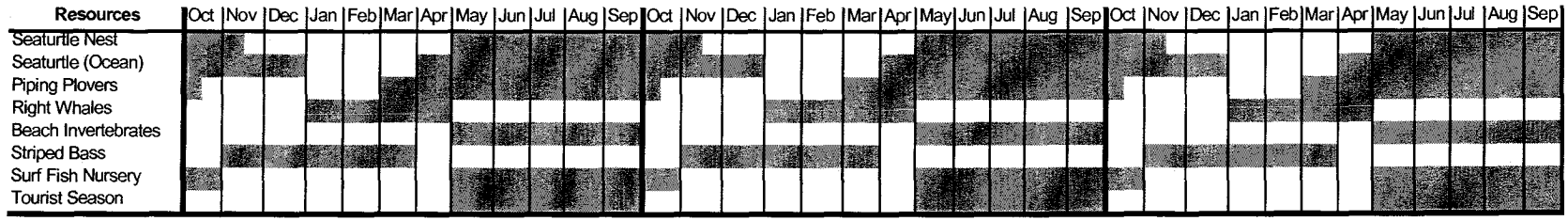
window may be made. It is proposed that nourishment would include 5 phases. It is possible that phases could be combined or completed in two cycles if needed. While the schedule for periodic nourishment is more restrictive than that proposed for construction, it does not avoid all significant resources. This schedule will further reduce impacts since dredging and disposal operations would occur during colder, less biologically productive, months.

4.06 Comparative Impacts of Proposed and Alternative Actions

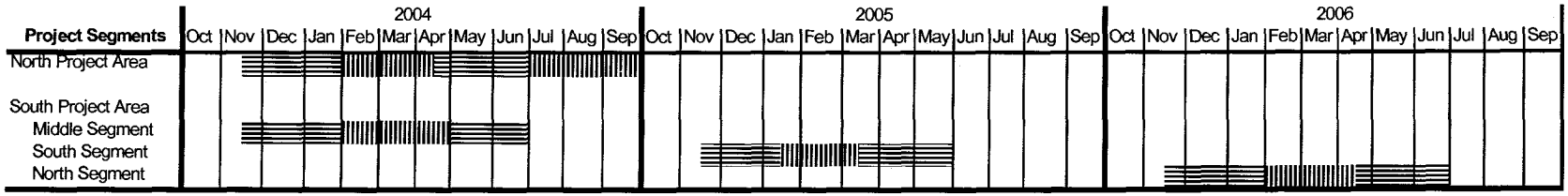
The alternatives considered include various beach fill alternatives (including the proposed plan), a non-structural alternative (relocation) and the no-action alternative. For beach fill alternatives the project extent would increase consistent with increases in the project dimensions. See Table 4-3 for a summary of the comparative impacts of the proposed plan to the Relocation (Nonstructural) and No Action alternative.

Figure 4-4. Project Schedule
Relative to Seasonal Occurrence of Significant Resources

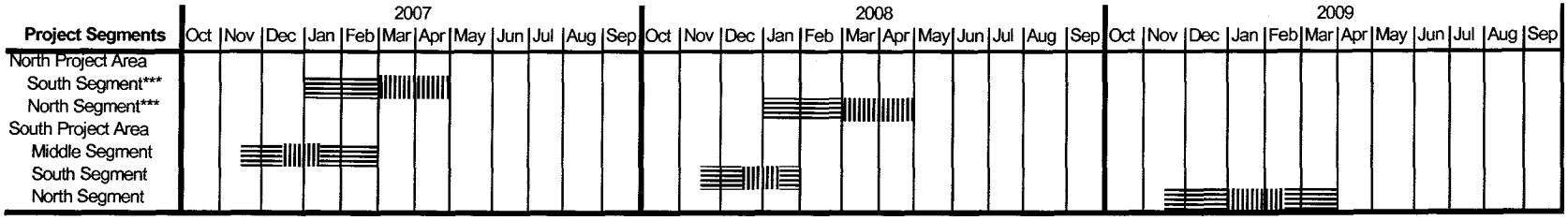
Seasonal Occurrence*



Initial Construction**



Periodic Nourishment**



Notes:
Resource Present
* Resources may be present other times of year
** Proposed schedule. Start dates may be delayed due to contracting concerns and construction periods may be extended or shortened due to work conditions.
*** Assumes hopper dredging. Southeast Regional NMFS BO doe not include windows.
~2 miles(+ or -)

TABLE 4-3. Comparative Impacts of the Proposed Plan to the Nonstructural and No Action Alternative

Resource	NED Plan and Berm Dune Alternatives	Non structural Alternative	No Action
Socioeconomic Resources	1. Improved recreational quality on expanded beach 2. Greater protection of oceanfront land, structures, and personal property 3. Economically Justified	1. More remote undisturbed beach 2. Eliminates need for future protection of structures. Land loss continues. 3. Displaces beachfront homeowners and businesses. Reduced tax base. Expected cost exceeds benefits.	1. Continued deterioration of the existing beach 2. Continued threat to oceanfront land, structures, and personal property 3. NED benefits foregone
Recreational and Aesthetic Resources	1. Improved appearance of beach will enhance recreational experience. Wider berm would increase recreation area. 2. Temporary inconvenience to beach users during initial construction and maintenance.	1. More natural appearance along the beach. Existing recreational capacity of beach maintained. Increased adjacent public lands. 2. Temporary inconvenience to beach users during demolition or removal of structures.	1. Status quo maintained 2. Status quo maintained

Resource	NED Plan and Berm Dune Alternatives	Non structural Alternative	No Action
Marine Resources	1. Temporary loss of invertebrates in borrow areas. Initial construction of NED plan. 2. Short term reoccurring loss of invertebrates along beach. 3. Reduces needs for annual beach scraping and sand bags 4. Short term, reoccurring impacts to fishing areas 5. Temporary impacts to adult, larval, and juvenile fish due to trubidity and reduced benthic food in dredging and disposal areas.	1. Status quo maintained 2. Status quo maintained 3. Eliminates needs for annual beach scraping and sand bags. Improved recovery of beach invertebrates 4. Temporary inconvenience to beach fishermen during demolition or removal of structures. Status quo maintained in near shore waters. 5. Status quo maintained.	1. Status quo maintained 2. Local shoreline protection continues including, beach scraping, sandbags and limited beach nourishment. Associated impacts to beach invertebrates would continue. Existing conditions allow little time for full recovery beach invertebrates. 3. Status quo maintained. 4. Status quo maintained. 5. Status quo maintained
Water Quality	1. Temporary elevated turbidities over existing conditions during initial construction and nourishment. 2. Temporary suspension of material during construction, nourishment.	1. Status quo maintained 2. Undetermined impacts as previously developed upland are eroded.	1. Status quo maintained 2. Status quo maintained

Resource	NED Plan and Berm Dune Alternatives	Non structural Alternative	No Action
Cultural Resources	1. No effects	1. Potential resource impacted by natural processes or storms. Relocation could affect any historic structures.	1. Potential resource impacted by natural processes or storms.
Threatened and Endangered Species	1. Nesting sea turtles may be affected. A monitoring and nest relocation program will be implemented when beach disposal occurs during the sea turtle nesting season. 2. May affect piping plover feeding areas.	1. Conditions for loggerhead and green sea turtle nesting would be improved by reduced disturbance and artificial lighting 2. Status quo maintained	1. Status quo maintained 2. Status quo maintained

5.00 AFFECTED ENVIRONMENT

The project is located on the Outer Banks of North Carolina, along the beaches of Northern Dare County. Dare County includes a peninsula of mainland east of the Alligator River, Roanoke Island and the Outer Banks from Sanderling to Hatteras. The main communities are the mainland areas of Manns Harbor, East Lake and Stumpy Point; the Roanoke Island towns of Manteo and Wanchese; and the Outer Banks communities of Southern Shores, Kitty Hawk, Kill Devil Hills, Nags Head, Rodanthe, Avon, Buxton and Hatteras. While Dare County covers 1,249 square miles, only 384 square miles are land, and the rest is made up of sounds and estuaries. Natural communities and significant resources in the project area are described below. Physical resources and water quality conditions are also discussed in this section. Significant resources present in the study area include socioeconomic resources, marine resources, terrestrial resources, threatened and endangered species, recreation and aesthetic resources, cultural resources and Section 122, P.L. 91-611 Resources.

5.01 Natural Communities

The natural communities in the project area that may be affected by the project are summarized below. Major communities and the species which characterize them are noted as appropriate. A more complete description of the communities is included in the Northern Dare County Storm Damage Reduction Project, Dare County, North Carolina Draft Fish and Wildlife Coordination Act Report dated July 1999. See Appendix B - Draft Coordination Act Report, USFWS.

5.01.1 Nearshore Ocean

Sand excavation and material disposal for beach and berm construction will occur in the near shore ocean in an area described by Day et al. (1971) as the "turbulent zone". The turbulent zone includes ocean waters from below low tide to a depth of about -60 feet. Potential borrow areas for sand, proposed for project construction and maintenance are located about 1 –2 miles off the beach in North Carolina state waters (within 3 miles of shore) between the –30 foot and –60 foot depth contour. Beach disposal will introduce fill into nearshore waters out to about the –20 foot depth. Benthic organisms, phytoplankton and seaweeds are the major primary producers in this community with species of *Ulva*, *Fucus*, and *Cladocera* being fairly common where suitable habitat occurs. Many species of fish-eating birds are typically found in this area, including gulls and terns, cormorants, loons and grebes. Marine mammals and sea turtles also are frequently seen in this area. Fishes and benthic resources of this area are discussed in Section 5.05.

5.01.2 Hardbottoms

Localized areas not covered by unconsolidated sediments, where the ocean floor consists of hard rock, are known as hardbottoms. Hardbottoms are found along the continental shelf off the North Carolina coasts. Hardbottoms are also called "live-bottoms" because they support a rich diversity of invertebrates such as corals, anemones, and sponges which are refuges for fish and other marine life. While hardbottoms are most abundant in southern portions of North Carolina, they are located along the entire coast (USFWS 1990). Data from the Southeast Monitoring and Assessment Program (SEAMAP) indicate that one area of hardbottom and one area of potential hardbottom are located near the proposed southern borrow areas (USFWS 1999). North Carolina has also constructed four artificial reefs in the project area. The location of these habitats in relation to project features is shown on figure 4-1.

5.01.3 Beach and Dune

When compared to most of North Carolina's upland communities, the beach and dune community in Dare County could be considered sparsely populated in both plants and animals. The environment on the beach is severe because of constant exposure to salt spray, shifting sands, wind, and sterile soils with low water retention capacity. Beach vegetation known from the area includes beach spurge (*Euphorbia polygonifolia*), sea rocket (*Cakile edentula*) and pennywort (*Hydrocotyle bonariensis*). The dunes are more heavily vegetated with American beach grass (*Ammophila breviligulata*), panic grass (*Panicum amarum*) sea oats (*Uniola paniculata*), broom straw (*Andropogon virginicus*) and salt meadow hay (*Spartina patens*) being commonly observed.

The beaches of the project vicinity are heavily used by migrating shorebirds. The U.S. Fish and Wildlife Service (1988) estimated that between 3,600 and 4,800 shorebirds may use the shoreline at the Pea Island National Wildlife Refuge during migration peaks. Similar numbers would be expected to occur north of Oregon Inlet on the undeveloped beaches of Cape Hatteras National Seashore. Although high shorebird use during migration also occurs along project area beaches, dense development and high public use of project area beaches may reduce their value to shorebirds. The dunes of the project area support fewer numbers of birds but can be very important habitats for resident species and for other species of songbirds during periods of migration.

Important invertebrates of the beach/dune community include the mole crab (*Emerita talpoida*), coquina clams (*Donax variabilis*), and ghost crabs (*Ocypode quadrata*). Through recent studies supported by the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers, the distributions and abundance of these animals on nearby beaches is fairly well documented. Despite frequent beach disposal on nearby Pea Island during maintenance dredging events, the numbers of

these animals remain high (Dolan and Donoghue 1996) and represent a significant food resource for the shorebirds and fishes of the area.

5.01.4 Maritime Shrub Thickets

This community normally occurs landward of the dune where it is protected from salt spray and the full force of ocean winds. It occurs on the barrier islands on each side of the inlet and is common along the highway and interspersed with marsh areas which border the sound. Dominant shrubs and trees in this community are wax myrtle (*Myrica cerifera*), yaupon (*Ilex vomitoria*), red cedar (*Juniperus virginica*), live oak (*Quercus virginiana*), and loblolly pine (*Pinus taeda*). Vines are also common with greenbriar (*Smilax bona-nox*), pepper-vine (*Ampelopsis arborea*) and grape (*Vitus rotundifolia*) being particularly abundant. This community type offers excellent cover for migrating songbirds.

5.01.5 Wetlands

These diverse communities occur on and behind the barrier islands of the project area. Many types of wetland communities are present in the project area; smooth cordgrass marsh, needlerush marsh, saltmeadows, and high marsh. All are important primary producers of organic matter and, therefore, serve as part of the base of the aquatic food chain. Smooth cordgrass (*Spartina alterniflora*) marshes occur within the intertidal zone along the sounds and tidal creeks, and provide valuable nursery habitat for many species of commercially valuable species of marine and estuarine organisms. Needlerush marsh is dominated by black needlerush (*Juncus romerianus)* and occurs in areas that are irregularly flooded. It occurs in large stands on the southern tip of Bodie Island where it provides buffering to the barrier island from sound side winds and waves. Saltmeadows are essentially pure stands of salt meadow cordgrass (*Spartina patens*) which can occur between 3.5-5.0 feet above mean sea level. Salt grass (*Distichlis spicata*), sea lavender (*Limonium carolinianum*) and sea ox-eye (*Borrichia frutescens*) are also prominent plants in this community. High marsh is a transitional community between high ground areas and wetlands and depending on location and frequency of flooding, may have characteristics of either. It is important in stabilizing the shifting sands of the barrier island. Given time and protection, it will eventually become vegetated with shrubs.

5.01.6 Inlet, Flats, and Sounds

The project area provides some of the finest examples of these habitat types on the eastern seaboard of the United States. Oregon Inlet serves as the major ocean outlet for the waters of the Roanoke and Chowan/Meherrin Rivers and many other smaller coastal rivers. It is this linkage of ocean waters with river flows which creates the valuable estuarine environment of the Albemarle/Pamlico system. The inlet is a critical migratory pathway for many organisms entering and exiting the sounds, including larval fishes and crustaceans, and anadromous and catadromous

fishes. Portions of the sound contain large intertidal sand and mud flats. Such areas attract many species of shore birds, especially during migration.

Pamlico Sound is a large estuarine system separated from the ocean by barrier islands. Many variables influence the character of the sound including river discharge, wind direction and force, inlet flows, etc. Because of its shallowness, the ever present winds of the region make Pamlico Sound a well-mixed system. Salinity near the inlet varies depending on tides and freshwater discharge and normally range between 10 and 32 parts per thousand (Hettler and Barker 1993). Tides near the inlet normally follow those of the sea, however, there are times when the combined forces of freshwater discharge and wind overwhelm incoming tides and force water out of the inlet throughout the tidal cycle. Below the surface of the sound is found a mosaic of shifting sand habitats, muds, and seagrass beds. These seagrass beds are extremely important habitat for a variety of commercially and ecologically important estuarine species, especially fishes and crustaceans.

5.02 Physical Resources

The "Outer Banks" of North Carolina are subjected to the most severe wave climate along the entire East Coast of the United States. This severe wave climate transports considerable quantities of sand along the adjacent beaches of the study area. A numerical modeling effort was undertaken to investigate the performance of the proposed beach project in this environment. The analysis included the simulation of wave transformation over the proposed offshore borrow areas for both the existing and future dredged conditions. The modeling was accomplished by the Corps of Engineers' Waterways Experiment Station (WES), Coastal and Hydraulics Laboratory (CHL) over the period of August 1999 through January 2000. Complete details of the modeling efforts by WES can be found in Draft Technical Report CHL-99-xx, dated 6 December 1999, entitled "Analysis of Wave Transformation, Littoral Sediment Transport and Beach Fill Performance: Dare County Beaches, North Carolina."

5.02.1 Wave Conditions

The CHL spectral wind-wave growth and propagation model STWAVE was chosen for wave transformation modeling given its ability to transform waves over the complex bathymetry existing offshore of Dare County. Waves selected as input to the STWAVE model were taken from the Wave Information Study (WIS) 20-year hindcast for years 1976 to 1995. The WES Wave Information Studies (WIS) have developed wave information along U.S. coasts by computer simulation of past wind and wave conditions. This type of simulation is termed hindcasting.

Waves typically approach the study area from east - northeast through east-southeast directions. The most frequently occurring wave heights range from 2 to 4 feet, with a mean wave height of about 2.8 feet. The largest waves occur from the east-northeast direction, these waves typically result from winter storms. Maximum

wave heights are on the order of 20 feet. During the summer months waves approach form the south-southeast, typically ranging from 1-2 feet in height.

5.02.2 Shoreline and Sand Transport

Results from the two wave transformation analyses (with and without dredged bathymetry) provided input to the second model, GENESIS (GENEralized model for Simulating Shoreline change). GENESIS was then used to predict changes in the project shoreline, as well as the corresponding southward, northward, net and gross littoral transport potentials along the study area. The GENESIS model was calibrated to match long-term shoreline change rates, as well as established sediment transport rates for the study area. The shoreline change rates were those developed by the North Carolina Division of Coastal Management, computed over the period 1945 to 1995. These rates ranged from approximately 3 feet of accretion to 10 feet of erosion per year over the project domain. Longshore sand transport rates computed with the model under average wave conditions under the without project condition were net and gross longshore sand transport rates of 762,000 and 2,184,000 cubic yards per year, respectively, averaged over the whole model domain. The modeled longshore transport rates are reasonably consistent with the net and gross rates documented by previous studies of the area.

5.03 Socioeconomic Resources

Dare County is located on the outer banks of North Carolina at the farthest eastern point of the coastal plain. The county seat of Manteo lies 180 miles east of Raleigh and 75 miles south of Norfolk, Virginia. The principal industries are tourism, construction, services, sport and commercial fisheries. The County is also home to a growing retirement population attracted to the area by a mild climate and beautiful natural surroundings. The Lost Colony, Wright Brothers Memorial, Cape Hatteras National Seashore, and the Pea Island National Wildlife Refuge generate tourism. Large numbers of vacation homes, motels, restaurants, and shopping centers have been developed to serve the local, retirement, and tourist populations. Ten of the twenty largest employers are related to the boating and fishing industries.

5.03.1 Base Socioeconomic Conditions

The population of Dare County grew at an annual rate of about six percent from 1980 to 1990, compared to the State of North Carolina's annual growth rate of 1.2 percent for the same period. The population of Dare County was 22,746 persons according to the 1990 census, but in 1998 was estimated to be 24 percent higher at 28,140. About 50 percent of the residents live in one of the county's municipalities. With its overwhelming economic emphasis on tourism, retail sales in Dare County comprise the most important source of jobs and income for the county's economy. Interestingly, Dare County has the smallest agricultural base of any North Carolina county, and its manufacturing sector is also one of the smallest of any county in the State.

The North Carolina Office of State Budget and Management estimates Dare County's 1998 employment at 15,925, with about 36 percent in retail jobs and 20 percent in services. In 1997, per capita income in Dare County was estimated at $21,624, somewhat higher than the North Carolina per capita income of $20,217.

The 1980's were a decade of rapid growth for the Dare County beaches. Table 5-1 shows the populations of the towns and Dare County since 1980. The total permanent population for the three principal towns in 1998 is estimated at 10,160. However, peak daily population in the summer can swell to more than 100,000 in these three towns and 250,000 for the entire county.

TABLE 5-1. Population Statistics for Dare County, North Carolina

Town/County	1998 Population	1990 Population	1980 Population
Nags Head	2,241	1,838	1,020
Kill Devil Hills	5,429	4,238	3,737
Kitty Hawk	2,490	1,937	N/A
Dare County	28,140	22,746	13,377

5.03.2 Projected Population

Dare County population projections for 2000 – 2020 are shown in table 5-2.

TABLE 5-2. Population Projections Dare County, North Carolina

County	2000 Population	2100 Population	2020 Population
Dare	29,569	36,674	43,765

Source: Office of State Planning, State of North Carolina.

5.04 Marine Resources

Marine waters in the vicinity of potential beach nourishment areas and offshore borrow sites provide habitat for a variety of ocean fish and are important commercial and recreational fishing grounds. Kingfish, spot, bluefish, weakfish, spotted seatrout, flounder, red drum, king mackerel and spanish mackerel are actively fished from boats, or the surf and local piers. Dr. Wilson Laney (1993 personal communication) indicates that nearshore ocean waters from Cape Lookout, North Carolina to Cape Charles Virginia are the wintering grounds for the Atlantic Coast migratory striped bass population. Offshore marine waters serve as habitat for the spawning of many estuarine dependent species. These species, according to Dr. Stan Warlen (NMFS letter dated January 5, 1993), "compose approximately 75

percent of commercially and recreationally important catch of fish and invertebrates in North Carolina". The surf zone serves as a nursery area for juvenile kingfish during the summer. These waters also accumulate juvenile, ocean spawning, estuarine dependent fish and invertebrates in the late winter and early spring prior to their transport through Oregon Inlet to Pamlico Sound estuary.

The intertidal zone within the proposed beach disposal area serves as habitat for invertebrates including mole crabs, coquina clams, amphipods, isopods, and polychaetes, which are adapted to the high energy, sandy beach environment. These species are not commercially important; however, they provide an important food source for surf-feeding fish and shore birds. Offshore bottoms, also provide habitat for benthic oriented organisms. Of special concern are hardbottom areas. Hardbottoms generally support a diversity of soft corals, anemones and sponges and provide habitat for reef fish such as black seabass, red porgy, and groupers. Hardbottoms are also attractive to pelagic species such as king mackerel, amberjack and cobia.

A more complete list of marine species found in the project vicinity is included in the USFWS Draft Coordination Act Report (DCAR) (USFWS 1999), Dare County Beaches (Bodie Island Portion) Feasibility Report, appendix B hereinafter referred to as appendix B.

5.04.1 Commercial and Recreational Fisheries

Commercial and recreational fishing are major industries along the Outer Banks. In the project area there are several major centers of fishing activity, recreational fishing centers at Manteo and the Oregon Inlet Fishing Center and a commercial fishing port at Wanchese. The project area is heavily used by all fishing interests including surf and pier fishermen, charter boats, and commercial gill netters and trawlers. Important commercial species include weakfish, dogfish sharks, and summer flounder. Total commercial landings through Oregon Inlet during 1993-1996 averaged about 29.5 million pounds. Lists of potential fish species and addition information on fisheries resources in the project area is provided in the USFWS DCAR (USFWS 1999), appendix B.

The beaches of Nags Head, Kill Devil Hills and Kitty Hawk are used by off road vehicles (ORV'S) and surf fishermen. These two interests constitute the major user groups of the project area and contribute to the local economy. ORV use on the beach is generally restricted to the months of October-April; however, numerous public beach access points are available for foot travel year round. There are 4 ocean piers located within the proposed project limits, Avalon Pier in Kill Devil Hills and Nags Head Pier, Jennett's Pier and the Outerbanks' Pier in Nags Head. These ocean piers, private recreational vessels, charter boats, and head boats that use the nearshore waters also contribute to the local economy.

5.04.2 Essential Fish Habitat

The 1996 Congressional amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (PL 94-265) set forth new requirements for the National Marine Fisheries Service (NMFS), regional fishery management councils (FMC), and other Federal agencies to identify and protect important marine and anadromous fish habitat. These amendments established procedures for the identification of Essential Fish Habitat (EFH) and a requirement for interagency coordination to further the conservation of Federally managed fisheries. The project area may include species that are managed by, or are of particular interest to, the New England, Mid-Atlantic and South Atlantic Fishery Management Councils, as well as the Atlantic States Marine Fisheries Commission. The NMFS Southeast Region is the point of contact (POC) for EFH coordination for this project. This assessment will be coordinated with the NMFS Southeast Region. Additional copies of the report will be provided to the POC for distribution to other fishery councils upon their request. Table 5-3 lists, by life stages, 77 fish species which may occur in the vicinity of Dare County Beaches Project, and which are managed under MSFCMA. These fish species and habitats require special consideration to promote their viability and sustainability. The potential impacts of the new proposed actions on these fish and habitats are discussed in Section 6.04 of this report. Table 5-4 shows the categories of EFH and Habitat Areas of Particular Concern (HAPC) for managed species which were identified in the Fishery Management Plan Amendments and which may occur in the project area. Essential Fish Habitats identified in the Final Habitat Plan for the South Atlantic Region identifies that may occur in the project area include hard bottoms, artificial/manmade reefs, and the marine water column including the surf zone and near shore ocean waters.

Table 5-3. Project Area Fish Managed under Magnuson-Stevens Fishery Conservation and Management Act

Fish Species	Oregon Inlet	Atlantic Ocean North of Cape Hatteras	Atlantic Ocean Offshore North Carolina
Red drum	E L J A	A	
Bluefish	E L J A	J A	
Summer flounder	L J A	E L J A	
Gag grouper	J A	E L J A	
Gray snapper	J A	E L J A	
Dolphin	J A	E L J A	
Cobia	E L J A	J A	
King mackerel	L J A	E L J A	
Spanish mackerel	L J A	E L J A	
Black sea bass	L J A	E L J A	
Spiny dogfish	E L J A	E L J A	
Brown shrimp	E L J A	E L J A	
Pink shrimp	E L J A	E L J A	
White shrimp	E L J A	E L J A	
Atlantic bigeye tuna	N/A	E L J A	
Atlantic bluefin tuna	N/A	E L J A	
Shortfin mako shark	N/A	J A	
Blue shark	N/A	J A	
Spinner shark	N/A	N/A	E L J A
Sword Fish	N/A	E L J A	E L J A
Yellowfin tuna	N/A	E L J A	E L J A
Skipjack tuna	N/A	E L J A	
Longbill spearfish	N/A	E L J A	

NOTES:
E – EGGS L - LARVAL J – JUVENILE A - ADULT
N/A – NOT FOUND

Table 5-3. Project Area Fish Managed under Magnuson-Stevens Fishery Conservation and Management Act (continued)

Fish Species	Oregon Inlet	Atlantic Ocean North of Cape Hatteras	Atlantic Ocean Offshore North Carolina
Blue marlin	N/A	E L J A	E L J A
White marlin	N/A	E L J A	E L J A
Sail fish	N/A	E L J A	E L J A
Calico scallop	N/A	E L J A	E L J A
Scalloped hammerhead shark	A	J A	J A
Big nose shark	A	J A	J A
Black tip shark	A	J A	J A
Dusky shark	A	J A	J A
Night shark	A	J A	J A
Sandbar shark	A	J A	J A
Silky shark	A	J A	J A
Tiger shark	A	J A	J A
Atlantic sharpnose shark	A	J A	J A
Longfin mako shark	A	J A	J A
Whitetip shark	A	J A	J A
Yellow jack	N/A	N/A	E L J A
Blue runner	N/A	N/A	E L J A
Crevalle jack	N/A	N/A	E L J A
Bar jack	N/A	N/A	E L J A
Greater amberjack	N/A	N/A	E L J A
Almaco jack	N/A	N/A	E L J A
Banded rudderfish	N/A	N/A	E L J A
Spade fish	N/A	N/A	E L J A
White grunt	N/A	N/A	E L J A
Hogfish	N/A	N/A	E L J A
Puddingwife	N/A	N/A	E L J A
Thresher shark	A	J A	J A
Gray triggerfish	N/A	N/A	E L J A

NOTES:
E – EGGS L - LARVAL J – JUVENILE A – ADULT
N/A – NOT FOUND

Table 5-3. Project Area Fish Managed under Magnuson-Stevens Fishery Conservation and Management Act (continued)

Fish Species	Oregon Inlet	Atlantic Ocean North of Cape Hatteras	Atlantic Ocean Offshore North Carolina
Blackfin snapper	N/A	N/A	E L J A
Red snapper	N/A	N/A	E L J A
Cubera snapper	N/A	N/A	E L J A
Silk snapper	N/A	N/A	E L J A
Vermillion snapper	N/A	N/A	E L J A
Blueline tilefish	N/A	N/A	E L J A
Sand tilefish	N/A	N/A	E L J A
Bank sea bass	N/A	N/A	E L J A
Rock sea bass	N/A	N/A	E L J A
Graysby	N/A	N/A	E L J A
Speckled hind	N/A	N/A	E L J A
Yellowedge grouper	N/A	N/A	E L J A
Coney	N/A	N/A	E L J A
Red hind	N/A	N/A	E L J A
Jewfish	N/A	N/A	E L J A
Red grouper	N/A	N/A	E L J A
Misty grouper	N/A	N/A	E L J A
Warsaw grouper	N/A	N/A	E L J A
Snowy grouper	N/A	N/A	E L J A
Yellowmouth grouper	N/A	N/A	E L J A
Scamp	N/A	N/A	E L J A
Sheepshead	J A	N/A	E L J A
Red porgy	N/A	N/A	E L J A
Longspine porgy	N/A	N/A	E L J A
Scup	N/A	E L J A	E L J A
Little tunny	N/A	N/A	E L J A

NOTES:
E – EGGS L - LARVAL J – JUVENILE A – ADULT
N/A – NOT FOUND

Table 5-4. Categories of Essential Fish Habitat and Habitat Areas of Particular Concern in Southeast States.[1]

ESSENTIAL FISH HABITAT	GEOGRAPHICALLY DEFINED HABITAT AREAS OF PARTICULAR CONCERN
Estuarine Areas	**Area – Wide**
Aquatic Beds	Council-designated Artificial Reef Special Management Zones
Estuarine Emergent Wetlands	Hermatypic (reef-forming) Coral Habitat & Reefs
Estuarine Scrub / Shrub	Hard Bottoms
Mangroves	
Estuarine Water Column	Hoyt Hills
Intertidal Flats	*Sargassum* Habitat
Oyster Reefs & Shell Banks	State-designated Areas of Importance of Managed Species
Palustrine Emergent & Forested Wetlands	Submerged Aquatic Vegetation
Seagrass	
	North Carolina
Marine Areas	
	Big Rock
Artificial / Manmade Reefs	Bogue Sound
Coral & Coral Reefs	Capes Fear, Lookout, & Hatteras (sandy shoals)
Live / Hard Bottoms	New River
Sargassum	The Ten Fathom Ledge
Water Column	The Point

[1]Areas shown are identified in Fishery Management Plan Amendments of the South Atlantic Fishery Management Council and are included in Essential Fish Habitat: New Marine Fish Habitat Mandate for Federal Agencies. February 1999. (Tables 6 and 7)

5.04.3 Surf zone fishes

The surf zone fisheries of the project area have not been studied. Surf zone fisheries are typically fairly diverse, with 52 species having been identified from North Carolina to date (Ross 1996, Ross and Lancaster 1996). The importance of surf zone habitat to maintain healthy stocks of certain species has only recently come under investigation. Preliminary studies by Ross and Lancaster (1996) indicate that juveniles of certain species may have high site fidelity and extended residence time

in the surf zone, indicating that the surf zone may be functioning as a nursery area. Two species in particular, the Florida pompano (*Trachinotus carolinus*) and gulf kingfish (*Menticirrhus littoralis*) seem to use the surf zone exclusively as a juvenile nursery area.

5.04.4 Larval fishes

Oregon Inlet is an important passageway for the larvae of many species of commercially or ecologically important species of fish. These larvae, hatched in the open ocean, migrate inshore and enter into the sounds through Oregon Inlet. The sounds with their abundant marshes, creeks, and sheltered areas, serve as nursery habitat where the young fish undergo rapid growth before returning to the ocean. There is recent evidence that fish larvae in the ocean waters near Oregon Inlet generally travel westward until they encounter the shoreline then migrate along the shoreline until they encounter the inlet (Dr. John Miller, N.C. State University, pers. comm.).

Larvae of 61 species of fish were recorded as using Oregon Inlet by Hettler and Barker (1993): Hettler and Barker (1993) found that different species of larval fish are transported through the inlet at different times of year and that there is no time of year in which there is no use by larval fish. The methods these fish larvae use to traverse large distances over the open ocean and find inlets is uncertain. Both passive and active transport methods are likely employed. Various environmental cues such as salinity, depth, temperature, swells, etc., may be important in directing these movements. During the period from October 1994 to April 1995, Hettler (1998) examined winter-immigrating larval fishes of Beaufort, Ocracoke, and Oregon Inlets. He found that these inlets were similar in temperature except that Oregon Inlet was slower to warm in the spring. In addition, he frequently encountered low temperatures in conjunction with salinities less than 10 ppt at Oregon Inlet. The consequences of such events on larval fishes is unknown but may occasionally limit successful recruitment at Oregon Inlet to later in the season when temperatures begin to rise. Hettler (1998) found that Oregon Inlet was heavily used by Atlantic croakers, with numbers averaging 155.5 larvae per 100 cubic meters of water. This far exceeded the use of any other inlet during his study period. Numbers of summer flounder were also significantly higher than at the other inlets examined. Densities of three other winter-immigrating species (spot, pinfish, and southern flounder) were higher in more southern inlets, a result which was anticipated given the more southern distributions of these species.

5.04.5 Wintering Fishes

The USFWS (1999) describes the importance of the project nearshore ocean as wintering habitat for migratory fish as follows: "Nearshore waters off the northern portion of the North Carolina Outer Banks, north of Cape Hatteras, have long been documented as an important wintering area for migratory fish populations, including Atlantic Coast migratory Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus;*

USFWS et al., unpublished data), spiny dogfish (*Squalus acanthias*) (Mid-Atlantic Fishery Management Council et al. 1998), striped bass (*Morone saxatilis*), and weakfish (*Cynoscion regalis*) (Pearson 1932; Parr 1933; Taylor 1951; M. Street, NC Division of Marine Fisheries, personal communication). Taylor (1951) reported that the Hatteras region "...is also a wintering area for migratory populations, and even, to some extent, a center of dispersal [p. 21]." Parr (1933) theorized that regions with moderate seasonal temperature change, which he termed "homothermous regions", serve as centers of concentration and dispersal. Taylor (1951, p. 32) noted that some species using NC coastal waters "...thrive in the extensive sounds during the long warm season, retreat to the warm offshore waters in the fall, and in part at least, migrate elsewhere in spring and summer as mature or advanced immature fish." He cited weakfish (a.k.a. gray sea trout) and striped bass (a.k.a. rock) as examples of species which exhibit this general life history pattern."

USFWS analysis of data from SEAMAP trawls between 1988 and 1997 indicate CPUE for striped bass ranged from a low value of 0.13 fish per thousand cubic meters at Site S2 in 1992, to a high of 35.35 fish at Site N2 in 1994. Mean CPUE value for all sites combined, between 1988 and 1997 was 4.13. The northern borrow sites, N1 and N2, had the highest CPUE for 8 of the 10 years for which data are compiled.

Analysis of feeding habitats of striped bass captured within or near proposed borrow areas by USFWS (1999), found fish to be the dominant prey in terms of frequency of occurrence, number and volume. Overall, the consumption of benthic invertebrates or benthic-consuming prey (sciaenids) was low. Fish prey was dominated by anchovies (*Anchoa* sp.). Clupeids including American shad (*Alosa sapidissima*), Atlantic herring (*Clupea harengus*), blueback herring (*Alosa aestivalis*), and menhaden (*Brevoortia tyrannus*) ranked second. Sciaenids were also included in the diet of striped bass during the years sampled. Species identified included: Atlantic croaker *(Micropogonias undulatus*), black drum (*Pogonias cromis*), and spot (*Leiostomus xanthurus*). Invertebrates comprised only a small fraction of the contents. Invertebrates which were identified included bivalve and gastropod mollusks (ark shell, *Anadara brasiliana* and dove shell, *Anachis obesa*), polychaete worms, portunid crab, sand shrimp (*Crangon septemspinosa*), sea cucumber (*Thyone briaereus*), and squid.

5.04.6 Benthic Resources -Beach and Surf Zone

The intertidal zone offshore is considered as being the area between mean low tide landward to the high tide mark. This area serves as habitat for invertebrate communities adapted to the high-energy sandy beach environment. Organisms in the intertidal community include mole crabs, coquina clams, amphipods, isopods, and polychaetes. Although none of these species are commercially important, they constitute considerable biomass and serve as an important food source for surf-feeding fish and shore birds.

5.04.7 Benthic Resources-Near Shore Ocean

The bottom substrate in the borrow areas typically consists of fine to medium sands. There was no evidence of any hard bottoms in the potential borrow areas based on analyses of data from the vibracore borings and analysis of side scan sonar records by Mid-Atlantic Technology and Environmental Research, Inc.. This information was obtained to assess the presence of cultural resources and describe bottom types within the potential borrow areas. The bottom in each area was identified as soft or compact sand. In general, soft sand was shown on the sonogram records as large sand waves compact sands were generally shown as indistinct or small sand waves.

Benthic surveys of three nearshore ocean sites located off nearby Virginia Beach (north of the project area) were conducted for the USDOI Minerals Management Service in 1996 and 1997 by Cutter and Diaz (1998). They collected a total of 119 taxa from 13 Smith-MacIntrye grabs collected in 1996. Half of the top 14 taxa (occurrence and abundance) were polychetes. The remainder included representatives from the amphiods, decapods, bivalves, nemerteans, tanaids, echniderms, and chordates. They found the overall community composition to be typical for sandy shallow continental shelf habitats and similar with species composition for similar depths and sediment types reported by Day et al. (1971) for North Carolina. Benthic resources in the proposed borrow sites are expected to also be similar to those found during these studies.

Table 5-5. Abundant benthic species within the turbulent zone near Cape Lookout North Carolina. (Day , 1971)

Group and Species	**Depth**			
	3 Meters	5 meters	10 meters	20 Meters
Archiannelida				
Polygordius sp.	X	X	X	X
Polychaeta				
Palaenous heteroseta		X	X	X
Pseudeurythoe ambigua			X	X
Exogone dispar			X	X
Goniadides n.sp			X	X
Magelona papillicornis	X	X	X	
Ophelia denticulata		X	X	X
Macroclymene zonalis				
Amphipoda				
Platyischnopus n.sp	X	X	X	
Maera sp.1		X	X	X
Decapoda				
Dissodactylus mellitae	X	X	X	

Table 5-5. Abundant benthic species within the turbulent zone near Cape Lookout North Carolina. (Day , 1971) (continued)

Group and Species	Depth			
	3 Meters	5 meters	10 meters	20 Meters
Pelecypoda				
Spisula ravenelli	X	X	X	X
Gastropoda				
Olivella adelae	X		X	X
O. mutica	X	X	X	
Echinoidea				
Mellita quinquiesperforata	X	X	X	X
Cephalochordata				
Branchiostoma caribbaeum		X	X	X

The most abundant species (total number > 50) collected by Day (1971) in waters within the turbulent zone near Cape Lookout North Carolina are shown on table 5-5. Polychaete species are highly represented. Abundant species also include pelecypods, decapods, amphipods, echinoderms, and Cephalochordates.

5.04.8 Nearshore Ocean Birds

Birds common to the nearshore ocean in the project area include loons, grebes, gannets, cormorants, scoters, red-breasted mergansers, gulls, and terns. The USFWS indicate that sea ducks raft in large numbers in the nearshore ocean waters of the project area during spring and fall migrations. Ducks, geese, and many kinds of shorebirds may also be found here during the spring and fall.

5.05 Terrestrial Resources

Along the ocean beach, blackbellied plovers, ruddy turnstones, whimbrels, willets, knots, semi-palmated sandpipers, and sanderlings may be found. Dinsmore et al (1998) determined that the Outer Banks, including the project area, provide a critical link during the migrations of sanderlings and wimbrels and are of great importance to a host of other shorebird species.

In the herbaceous dune areas, marsh hawks, kestrels, and other bird of prey forage and ring-necked pheasants feed near denser cover. Other birds occurring in this area are mourning doves, swallows, fish crows, starlings, meadowlarks, redwinged blackbirds, boat tailed grackles, and savannah sparrows. Mammals occurring here are opossums, cottontails, gray foxes, raccoons, feral house cats, shrews, moles, voles, and house mice.

Colonially nesting waterbirds (gulls, terns, and wading birds) are an important part of the project area ecosystem and add a vital element to the overall aesthetic appeal of

the area for the many tourists that visit it each year. These species formerly nested primarily on the barrier islands of the region but have had most of these nesting sites usurped by development or recreational activities. With the loss of their traditional nesting areas, these species have retreated to the relatively undisturbed dredged material disposal islands which border the navigation channels in the area. These islands often offer ideal nesting areas as they are close to food sources, well removed from human activities, and are isolated from mammalian egg and nestling predators.

Species of colonial waterbirds have been documented to nest on the disposal islands or beaches of the project area are shown on Table 5-6. Other species also use the islands for loafing or roosting during migratory periods or the winter months.

Table 5-6. Colonial waterbirds that have been documented to nest on the disposal islands or beaches in Dare County NC.

least (little) tern (*Sterna albifrons*)
Caspian tern (*Sterna caspia*)
common tern (*Sterna hirundo*)
gull-billed tern (*Gelochelidon nilotica*)
black skimmer (*Rynchops niger*)
royal tern (*Sterna maxima*)
sandwich tern (*Sterna sandvicensis*)
laughing gull (*Larus atricilla*)
herring gull (*Larus argentatus*)
great black-backed gull (*Larus marinus*)
brown pelican (*Pelecanus occidentalis*)
glossy ibis (*Plegadis falcinellus*)
white ibis (*Eudocimus albus*)
black-crowned night-heron (*Nycticorax nycticorax*)
yellow-crowned night-heron (*Nyctanassa violacea*)
great egret (*Casmerodius albus*)
snowy egret (*Egretta thula*)
tricolored heron (*Hydranassa tricolor*)
little blue heron (*Florida caerulea*)
green-backed heron (*Butorides striatus*)
cattle egret (*Bubulcus ibis*)

5.06 Recreation and Aesthetic Resources

The Towns of Kitty Hawk, Kill Devil Hills and Nags Head are urbanized beach communities characterized by paved streets, parking lots, hotels, single family dwellings, and condominiums. The aesthetic values of these beach communities are evidenced by the popularity of the area for family orientated use and tourism. The total environment of barrier islands, oceans, estuaries, and inlets attract many residents and visitors to the area to enjoy the total aesthetic experience created by

the sights, sounds, winds, and ocean sprays. Five ocean fishing piers are located in the study area. These are considered important recreational facilities.

5.07 Water Quality

Coastal waters offshore of Dare County Beaches are classified "SB" by the State of North Carolina (NCDEM 1989). Best usage of class SB waters includes swimming, primary recreation, and all Class SC uses including fishing, secondary recreation, fish and wildlife propagation, and other uses requiring lower water quality (NCDEM 1991).

5.08 Cultural Resources

Dare County holds a unique place in American history, including two important firsts: Roanoke Island was the site of the first English settlement in North America, and the world's first successful powered flight took place at Kill Devil Hills. The protected sounds have offered safe anchorage for generations of mariners, and many of the county's residents are still employed in a variety of maritime trades. The eastern extension of the Outer Banks places the area close to Atlantic shipping lanes and accounts in part for the area's continued reliance on maritime industry and also for its abundance of shipwrecks.

Certainly the most well known event in Dare County's early history is the focus of English attempts at settlement on Roanoke Island. Although there were probably brief incidental landings of Europeans on the Outer Banks as early as the mid-1500s, the first attempts at permanent English settlement were sponsored by Sir Walter Raleigh in 1585. Raleigh's Roanoke expeditions were filled with such adventures and difficulties that they have made legends of the voyagers and the voyage. The honor of the first attempt at settlement was given to Ralph Lane, whose small settlement was completely dependent upon Native Americans for support. Since most of Lane's party could not adjust to life under such primitive coastal conditions, most returned to England in 1587 with Sir Francis Drake. The small group of settlers that remained on Roanoke Island was later joined by an expedition led by John White. After establishing a base of operations, White also returned to England to gather much needed supplies for his settlement. But White was seriously delayed by events surrounding Spain's attempted invasion of England and it was nearly three years before he was to return to Roanoke Island, only to find the settlement abandoned. These early colonists have never been accounted for. White attempted to reestablish the colony but he was eventually forced to give up the settlement for good. This period of settlement and exploration is memorialized at the Fort Raleigh National Historic Site and at the State Historic Site, *Elizabeth II*, which features a replica of the smallest of the three ships that brought Raleigh's original settlers to North America. A reenactment of the hardships faced at the Roanoke settlements is played out throughout the summer tourist season at the outdoor drama *The Lost Colony*. Dare County takes its name from Virginia Dare, the first English child born in the New World.

The other high profile event that occurred in the county, is the flight of the Wright brothers. In 1903, Orville and Wilbur Wright traveled from their Dayton, Ohio home to Kill Devil Hills to test their newest powered aircraft design. Although others had attempted powered flight, no one, including the Wright brothers, had managed to sustain a powered flight until December 17 of that year. The flight was important because Orville Wright flew "The Flyer" from the ground under its own power, maintained its speed under controlled flight, and then landed at a point as high as that from which he had taken off. This site is commemorated at the Wright Brothers National Memorial at Kitty Hawk.

Dare County and the Outer Banks have long been associated with fishing, seafaring, and maritime trade. However, the development of major ports and terminals has been tempered by difficult currents, shoals, and shifting inlets that characterize this portion of North Carolina's coast. Indeed, these are among the most treacherous waters in the Atlantic. Many of the nation's earliest shipwrecks occurred off of the Outer Banks, with losses recorded as early as 1528. Sir Francis Drake himself lost several ships near the Roanoke colony in 1585, as did John White. In the centuries that followed exploration and settlement, literally thousands of vessels have been lost on and near the Outer Banks and an inordinate number of these were lost between Cape Lookout and the Chesapeake Bay. The Outer Banks certainly deserves its epithet "Graveyard of the Atlantic".

Historic documentation undertaken by the NC Division of Archives and History indicates that there are at least 144 known vessel losses recorded for the offshore area north of Oregon Inlet, and at least 20 known locations of wrecks and wreckage. The turbulent waters of the Outer Banks regularly break loose portions of offshore wrecks, depositing portions of keels, hull, framing and other wreckage on area beaches. This large number of shipwrecks and their frequent appearance on the shoreline indicates that the Dare County Beaches borrow and nourishment areas are located in areas of potential sensitivity for shipwreck remains. Therefore, the U.S. Army Corps of Engineers has undertaken a survey of both the offshore borrow areas and the on-shore enrichment zone. The offshore survey consisted of a magnetometer and side-scan sonar survey of the ocean floor. The beach survey was a visual search for wreckage that might represent historic shipwrecks. These surveys were designed to assure that offshore wrecks would be documented and avoided during construction, and that portions of vessels found on the beachfront would be photographed and documented on state site forms. Upland wreckage is also routinely tagged with a unique state site number and then flagged so that it could be avoided by heavy equipment involved in the nourishment effort.

5.09 Threatened and Endangered Species

Many threatened and endangered species of plants and animals potentially occur in the project area. Table 5-7 is a list these species.

5.09.1 Right Whale

Current right whale stocks in the North Atlantic are estimated to be a few hundred individuals. The species summers in the region of the Bay of Fundy and overwinters in the nearshore waters of south Georgia and northern Florida. North Carolina sightings of right whales represent migrating individuals. Right whales swim very close to the shoreline and are often noted only a few hundred meters offshore (Schmidly, 1981). This species occurs infrequently in the ocean off the coast of North Carolina, usually in association with spring migrations. Right whales have been documented along the North Carolina coast, as close as 250 meters from the beach, between December and April (Dr. Frank J. Schwartz, personal communication). Sightings are most common from mid to late March.

Right whales feed primarily on copepods and euphausiids (Schmidly, 1981). Calves are produced in late winter and become sexually mature in about 8 years. Females are believed to calve about every three to four years.

There are no documented threats to the right whale in the vicinity of Dare County Beaches. Destruction or pollution of right whale habitat is not known to be a problem in the project area. The only potential threat to the right whale is from collision with boats navigating in the ocean.

5.09.2 Finback whale, humpback whale, sei whale, and sperm whale

These species all occur infrequently in the ocean off the coast of North Carolina. Their occurrence in the State's waters is usually associated with spring or fall migrations. Since 1991 humpback whales have been seen in nearshore waters of North Carolina with peak abundance in January through March (USFWS 1999).

5.09.3 Florida Manatee

The manatee is only an "occasional seasonal visitor to North Carolina waters", with populations which are "presumed to be low" (Clark, 1987). As reported by the USFWS in their Draft Coordination Act Report (USFWS1999) Schwartz (1995) indicates that the species has been recorded in 11 coastal counties of North Carolina, including nine reports from Dare County. Four North Carolina records have been from inlet-ocean sites and six occurred in the open ocean. Open ocean reports include single sightings off Avon and Kitty Hawk, both in Dare County. Manatees have been reported in the state during nine months, with most sightings in the August-September period. Within Dare County, manatees have been reported from Pamlico Sound (June 1975, September 1983, October 1983), Albemarle Sound (September 1983, October 1983), Collington Bay near Kitty Hawk (September-October 1986), Wanchese Harbor (September 1983), and the vicinity of Rodanthe (September 1987) (Schwartz 1995). All of these records fall between late June and the end of October however, there is no information available which would allow the prediction of its occurrence at any given site at any given time. Therefore, while the

manatee has been reported from Dare County within the project area, there is no attainable probability, or reliable way, of predicting its occurrence there again during any given time period. Studies currently underway by the USFWS using animals fitted with satellite transmitters will hopefully shed some light on the nature of these seasonal movements.

Table 5-7. Threatened and Endangered Species Listed for Dare County

MAMMALS
Finback whale (*Balaenoptera physalus*) - Endangered
Humpback whale (*Megaptera novaeangliae*) - Endangered
Right whale (*Eubaleana glacialis*) - Endangered
Sei whale (*Balaenoptera borealis*) - Endangered
Sperm whale (*Physeter catodon*) - Endangered
Florida manatee (*Trichechus manatus*) - Endangered

BIRDS
Arctic peregrine falcon (*Falco peregrinus tundrius*) - Threatened
Bald eagle (*Haliaeetus leucocephalus*) - Endangered
Piping plover (*Charadrius melodus*) - Threatened
Roseate Tern (*Sterna dougallii*) - Endangered

REPTILES
American alligator (*Alligator mississippiensis*) - Threatened/SA*
Green sea turtle (*Chelonia mydas*) - Threatened
Hawksbill sea turtle (*Eretmochelys imbricata*) - Endangered
Kemp's ridley sea turtle (*Lepidochelys kempi*) - Endangered
Leatherback sea turtle (*Dermochelys coriacea*) - Endangered
Loggerhead sea turtle (*Caretta caretta*) - Threatened

FISHES
Shortnose sturgeon (*Acipenser brevirostrum*) - Endangered

PLANTS
Seabeach amaranth (*Amaranthus pumilis*) - Threatened

* The American alligator is listed as threatened only under similarity of appearance. Section 7 consultation is not required.

5.09.4 Arctic Peregrine Falcon

The Arctic peregrine falcon is a regular fall migrant in the project area. These birds are believed to be spring and summer residents of Greenland and adjacent areas, on their way to wintering grounds in the southern United States, West Indies, and Central and South America. They usually move through the project area in greatest numbers during late September and early October and have been known to

overwinter in the area. An average of two peregrine falcons has overwintered in the project region over the past 20 years. The principal causes of the decline of this species are biomagnification of chlorinated hydrocarbon pesticides and capture by falconers. Neither of these problems is known to be present in the project area.

5.09.5 Bald Eagle

The bald eagle ranges throughout eastern North Carolina. While it is known that the species occasionally uses the project area, there are no known roosting or nesting areas within the project limits. The species feeds principally on fish and is, therefore, dependent on water quality sufficient to maintain an adequate forage base.

5.09.6 Piping Plover

The piping plover is a fairly common winter resident along the beaches of North Carolina (Potter, et al., 1980). Project specific information is provided by Nicholls (1989) who determined that Oregon Inlet provides wintering habitat for 4 percent of North Carolina's total wintering piping plover population. Each winter, 2 to 5 piping plovers overwinter in the vicinity of the inlet.

The species is known to nest in low numbers in widely scattered localities on North Carolina's beaches. During a statewide survey conducted in 1988, 40 breeding pairs of piping plovers were located in North Carolina. LeGrand (1984a) states that "all of the pipings in the state nest on natural beachfronts, both completely away from human habitation and [yet] in moderate proximity to man". The largest reported nesting concentration of the species in the State appears to be on Portsmouth Island where 19 nests were discovered in 1983 by John Fussell (LeGrand, 1983). The southernmost nesting record for the state was one nest located in Sunset Beach by Phillip Crutchfield in 1983 (LeGrand, 1984b).

Pearson, et al., (1942) reported nesting by this species on Pea Island in both 1901 and 1902. In spite of summer sightings of this species on the sandflats on the Bodie Island side of Oregon Inlet, the species has not been found to be nesting there (Harry LeGrand, pers. comm.). The species has nested on the Pea Island National Wildlife Refuge near Oregon Inlet every year since 1998. Young were fledged in 1998 and 1999 but it is not known if any young were successfully fledged in 2000 (Dennis Stewart, personal communication). The species typically nests in sand depressions on unvegetated portions of the beach above the high tide line. Specific habitats include: sand flats on sand spit ends and barrier islands, gently sloping foredunes, blowouts behind primary dunes, washover areas on barrier islands, and dredged material disposal areas on barrier islands (USFWS, 1996). Nesting usually begins in late April and nests have been found as late as July (Potter, et al., 1980; Golder, 1985). The piping plover feeds on shoreline areas including beaches and mudflats (Potter, et al., 1980). Food organisms include worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates (Bent 1928).

The beaches proposed for berm and dune construction receive heavy use by the public. Such use disturbs foraging and nesting shorebirds and, consequently, degrades its potential as piping plover habitat according to the U.S. Fish and Wildlife Service (1989). Since project beaches are wintering area for the species, the major threats to its continued occupation of the area during the winter months would be continued degradation of beach foraging habitat. Similar degradation of beaches elsewhere could be a contributing element to declines in the state's nesting population.

5.09.7 Roseate Tern

In North Carolina, the roseate tern is most frequently found as a transient between late March and mid-May in the spring and late-July to October in the fall (Potter, et al., 1980). One nesting has been recorded for the state. This nesting occurred on a dredged material disposal island near Core Banks, Carteret County, in 1973. Recently summer records of this species have been reported but breeding has not been recorded. It frequently breeds in mixed colonies in close association with common terns. Pearson, et al. (1942) record four specimens from the state, all from the Outer Banks. Of these four, three were from August and one, inexplicably, from January. Currently, nesting by this species in the U.S. is restricted to isolated locales in New England and Florida. Like other terns, this species feed by diving from the air upon small fish swimming near the surface of the water. There are no records that the species nests in the project area (USFWS 1999).

5.09.8 Hawksbill, Leatherback, and Kemp's Ridley Sea Turtles

None of these species is known to nest regularly along the North Carolina coast. In North Carolina, the Kemp's ridley sea turtle is known from estuarine and oceanic waters, whereas the leatherback and hawksbill are normally associated with oceanic waters (Schwartz, 1977; Lee and Palmer, 1981); however, both species have been documented to have come through Oregon Inlet into Pamlico Sound. The hawksbill and leatherback are considered to be residents of North Carolina waters from the spring through the fall (Schwartz, 1977; Lee and Palmer, 1981). Epperly and Veishlow (1989) report Kemp's ridley sea turtles from the sounds of North Carolina from October through December, while Schwartz (1977) reports estuarine records from as early as July. Lee and Palmer (1981) report a stranded Kemp's ridley from Pea Island in April 1975.

These species of sea turtles feed on a wide variety of invertebrates and occasionally some plant material. Since nesting by these species in the State is rare, the most significant threats posed to them while in the State are from accidental drowning by trawling activity.

5.09.9 Loggerhead and Green Sea Turtles

In the project area, the green and loggerhead sea turtles are known from both estuarine and oceanic waters. Both of these species are considered to be residents of North Carolina waters primarily from the spring through the fall although occasional winter records exist. Of these two species only the loggerhead is considered to be a regular nester in the state, while the green nests only sporadically. For the purposes of this assessment, the loggerhead and green sea turtles are considered to be the only species likely to nest in the project area.

The project area receives relatively light nesting by sea turtles. Nesting densities for eighteen miles extending from Kitty Hawk to south Nags Head are given, by management zone, in the table below (data provided by Ruth Boettcher, N.C. Wildlife Resources Commission). Management zones are measured in one-mile increments starting at the Virginia/North Carolina State line and progressing southward. Numbers in the table represent loggerhead nests except where otherwise noted.

Table 5-8, shows the number of recorded sea turtle nests in 20 one-mile Sea Turtle Management Zones (STMZ) that extend from Kitty Hawk (# 34) to 1 mile south of the Cape Hatteras National Seashore boundary (#53). Data covers the nesting seasons during 1990 through 1998. All nests were laid by loggerhead sea turtles except as noted (* = a single, confirmed green turtle nest). Source: Sea Turtle Coordinator, North Carolina Wildlife Resources Commission.

A total of 28 nests were counted in the study area between 1990 and 1998. Nests per year range from 1 to 6 and average about 3 per year. Green sea turtle nesting in the project area is represented by only one recorded nest. Because of this limited record of occurrence, the species cannot be considered to be a regular nester within the project area. As part of the terms of local cooperation, the project area will be monitored for sea turtle nesting and hatchling activity on an annual basis.

Light pollution is a recognized concern with both nesting females and hatchlings as it is known to keep females from selecting otherwise suitable beach nesting areas and confuses hatchlings which, upon exiting the nest, should take the shortest route to the sea. The glare from artificial lighting can result in a disorientation of hatchlings, resulting in their travelling across dunes and roadways. During Construction, lighting will be controlled as described in section 6.12.

Table 5-8. Number of Sea Turtle Nest in the Dare County Beaches Project Area

	Year									
STMZ	90	91	92	93	94	95	96	97	98	Total
34	0	0	0	0	0	0	1	0	0	1
35	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0
37	1	0	0	0	0	0	0	0	0	1
38	0	0	0	0	0	0	0	0	1	1
39	0	0	0	0	1	0	1	0	1	3
40	0	0	0	0	0	1	0	1	1	3
41	0	0	0	0	0	1	0	0	1	2
42	1	1	1	0	0	0	0	0	0	3
43	0	0	0	0	0	1	0	0	0	1
44	0	0	0	0	0	0	0	0	0	0
45	0	0	1	1	0	0	0	0	0	2
46	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	2	1	0	1	4
48	0	0	0	0	0	0	2*	0	0	2
49	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	2	0	0	0	0	2
53	0	1	1	0	0	0	0	0	1	2
Total	2	2	3	1	3	5	5	1	6	28

5.09.10 Shortnose Sturgeon

The shortnose sturgeon ranges along the Atlantic seaboard from the Saint John River in New Brunswick, Canada, to the Saint Johns River, Florida. It is apparent from historical accounts that this species may have once been fairly abundant throughout North Carolina's waters. There are historical records of the shortnose

sturgeon in the vicinity of the project, both in Albemarle Sound and the nearshore ocean (Dadswell, et al., 1984). However, in the recent past, this species was thought to be extirpated from North Carolina (Schwartz, et al., 1977). During the winter of 1986-87, the shortnose sturgeon was taken from the Brunswick River, a component of the Cape Fear River basin. With this discovery, the species is once again considered to be a part of the state's fauna; however, there are still no recent records of the species from the project area.

The shortnose sturgeon is principally a riverine species and is known to use three distinct portions of river systems: (1) non-tidal freshwater areas for spawning and occasional overwintering; (2) tidal areas in the vicinity of the fresh/saltwater mixing zone, year-round as juveniles and during the summer months as adults; and (3) high salinity estuarine areas (15 parts per thousand (ppt) salinity or greater) as adults during the winter.

The shortnose sturgeon is a bottom feeder, consuming various invertebrates and, occasionally, plant material. Adults are found in shallow-to-deep water (6 to 30 feet) and would be expected to occupy deep water areas during the day and the more shallow adjacent areas during nighttime foraging periods (Dadswell, et al., 1984). Pollution, dam building, and over-fishing are generally considered to have been the principal causes of the decline of this species.

5.09.11 Seabeach Amaranth

Seabeach amaranth is an annual or sometimes perennial plant that usually grows between the seaward toe of the dune and the limit of the wave uprush zone. Greatest concentrations of seabeach amaranth occur near inlet areas of barrier islands, but in favorable years many plants may occur away from inlet areas. It is considered a pioneer species of accreting shorelines and stable foredune areas.

Recent surveys conducted by the Corps in September 1997 and July 1998 did not identify any populations of seabeach amaranth in the project area. The nearest populations to the project area are Cape Point, North Carolina, to the south and Long Island, New York, to the north. Its absence from the project area is likely due to a lack of suitable habitat or a suitable seed source.

5.10 Other Significant Resources (Section 122, P.L. 91-611)

Section 122 of P.L. 91-611 identifies other significant resources that must be considered during project development. These resources, and their occurrence in the study area, are described below.

a. Air, noise, and water pollution: There are no known air quality problems in the study area. Noise is a prominent feature in the study area due to the sound of the breakers. These sounds are tranquil and add to the pleasure experienced by visitors. Water quality is discussed in

Section 5.06 and in the Section 404(b)(1) (P.L. 95-217) evaluation included with this document as attachment A.

b. Man-made and natural resources, aesthetic values, community cohesion, and the availability of public facilities and services: Four of the five ocean piers in the project area are within the proposed fill area. Aesthetic values are discussed in Section 5.05. There are four stormwater drainage outlets discharging to the beach along the study area. Three outlets include two 24" pipes and the fourth has only one 24" pipe. A discharge for the Dare County Reverse Osmosis plant is located between the north and south project reach and will be unaffected by the project. There are about 50 public beach access points with cross over structures along the project reaches. The sites are located at street ends on the landward side of the dune. Limited parking is available at many of the sites. At this time no additional sites are proposed for construction by the local sponsor.

c. Employment, tax, and property value: The study area is a major resort area in Dare County. Property values contribute to the tax base.

d. Displacement of people, businesses, and farms: Homes along the study beach are being threatened with displacement as a result of beach erosion. The NED plan includes the acquisition of 8 homes, one swimming pool, and one outbuilding. There will be no utility relocations and there are no existing Federal projects within the acquisition area. There are no farms in the area which would be affected by the NED plan alternative.

e. Community and regional growth: Project area beaches have undergone rapid population growth in recent decades. This is expected to continue with or without the proposed project.

6.00 ENVIRONMENTAL EFFECTS

This section describes the probable consequences (impacts and effects) of the selected alternative on significant environmental resources within the project area.

6.01 Natural Communities

Natural communities that would be affected by the proposed action include the beach and dune and nearshore ocean as described below. Maritime shrub habitat, wetlands, hardbottoms and inlets, flats and sounds would not be affected. A no action alternative would maintain the status quo. Existing impacts to beach and dune habitats from local protection activities would continue; however, no new impacts to the nearshore ocean would be expected. A relocation alternative would have undetermined impacts on the beach and dune and ocean waters as previously developed uplands are eroded. Maritime shrub and wetlands could be affected by relocations if found in newly developed construction areas.

6.01.1 Beach and Dune

Under the proposed plan 14.2 miles of beach berm and dune (including transition areas) would be constructed. Dunes will tie into existing dunes where practical and be revegetated with native dune grasses to minimize impacts. About 9,000 feet of beach on Cape Hatteras National Seashore which are presently eroding will receive sand indirectly from littoral transport of sand from the adjacent construction area. This will result in a seaward movement of the shoreline as described in section 6.02.

6.01.2 Nearshore Ocean

Two borrow areas (S1 and N1) will be excavated in the nearshore ocean. Excavation will directly impact an area of about 7 square miles when completely utilized (year 50). Initial construction will impact a total area of about 1 square mile of sandy ocean bottom. Multiple dredging areas within a given borrow site may be used to reduce material transport and/or allow for concurrent operation of more than one dredge in a given area. A typical borrow section is shown in figure 6-1. Existing depths at the proposed borrow sites range from 30' to 60'. The depth of cut will vary depending on the availability of suitable sandy material and dredge plant capabilities. The average proposed cut is 12' in the southern borrow site (S1) and 9' in the northern site (N1). Maximum cuts for these areas would be about 20' and 12' respectively. It is proposed that a given dredging area would be used for only one operation. Some refilling from sedimentation and side sloughing is expected over time. It is expected, however, that the depression created by the removal of sand will persist. The Minerals Management Service (1999) indicates that the bottom substrate at and near a borrow site may be modified in several ways. A change in the hydrologic regime as a consequence of altered bathymetry may result in the deposition or scour of fine sediments, which may result in a layer of sediment that differs from the existing substrate.

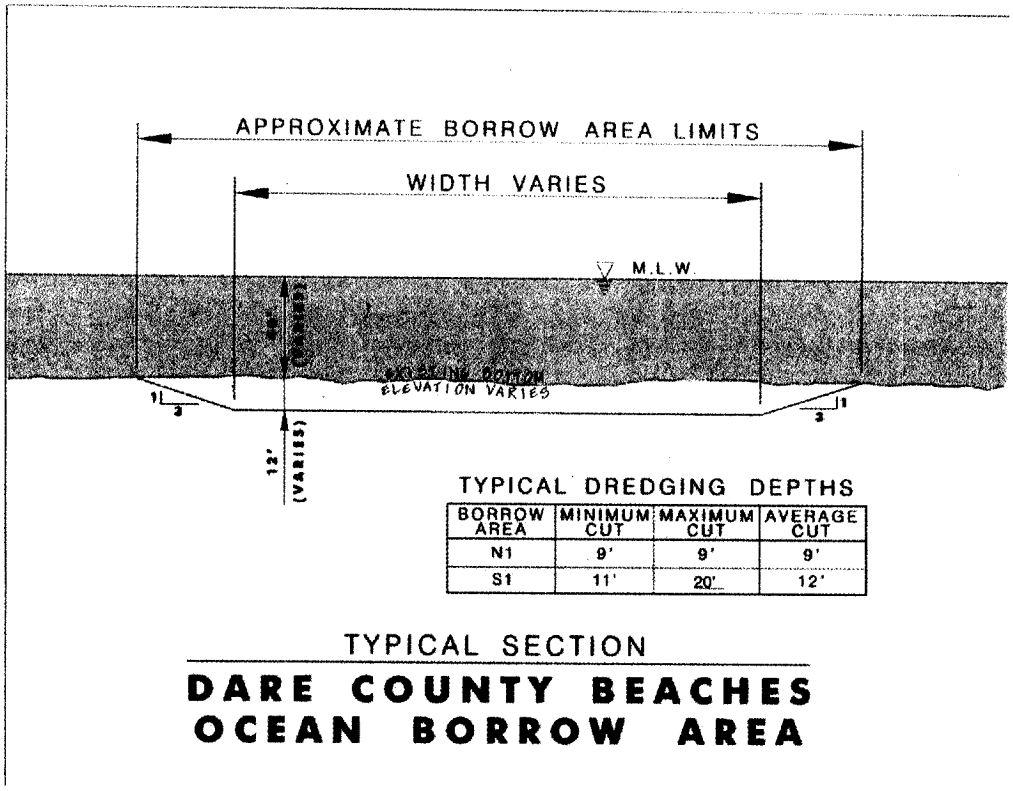


Figure 6-1. Typical Borrow Area Cross Section

6.02 Physical Resources

The recommended NED plan was incorporated into the GENESIS model, effectively moving the existing beach profile an average of 150 feet seaward of its present location. The proposed project will create seaward protuberances in the shoreline that will increase rates of longshore transport, particularly at the ends of the fills. Accordingly, GENESIS simulations were used to evaluate transition lengths at the ends of the projects and the overall project performance at the end of a 3-year renourishment cycle. Simulations were run over a 3-year cycle for both the North and South Project. These initial runs indicated that the project design berm width of 150 feet would not be maintained in the North Project or at the ends of the South Project regardless of the transition length. Accordingly, a second set of model simulations were made to quantify the volume of sand required to maintain the 150-foot minimum design berm width and also to quantify the berm width that would be provided by the original renourishment plan using a sequence of multiple renourishment cycles. Two other cases evolved where renourishment material was added non-uniformly along the project reach based upon the shoreline response at the end of the prior cycle. This type of simulation mimics how the project would operate under prototype conditions. Additional model simulations were performed to

examine sensitivity of the project evolution under very high transport conditions and drift reversals.

6.02.1 Wave Transformation

Modeling results indicate that dredging will have minor impacts on nearshore waves shoreward of borrow areas when the borrow areas are fully depleted at the end of the 50-year project life. These impacts are quite variable spatially, increasing wave height in some areas and decreasing it in other areas. The magnitude of the wave height change is generally small, ranging from plus 3 to minus 5 percent. Changes in wave angle are generally limited to plus 3 to minus 3 degrees. General trends for the North Project show that wave heights, although variable, are expected to be lower over the northern most 1,000 feet of the project and then larger over the next 1,000 feet. Elsewhere in the North Project area, the incident wave conditions are expected to be relatively unchanged. Expected changes in wave conditions for the South Project for the fully dredged condition are that wave heights are expected to be larger over the northern most 5,000 to 10,000 feet, followed by generally lower wave heights over the remainder of the South Project.

Under dredged conditions, projected sand losses from the beach fill in the northern half of the North Project will increase, while sand losses from the beach fill in the southern half are projected to decrease. However, over the entire North Project area, average sand losses are expected to be less under fully dredged conditions.

For the South Project, the response is more complex. Over the northern half of the South Project wave transformation over the dredged bathymetry is expected to cause a minor increase in sand losses. However, in the southern half of the South Project wave transformation over the dredged bathymetry is predicted to induce shoreline advancement over the middle reaches bordered by an area of shoreline retreat over the southernmost 8,000 feet.

6.02.2 Periodic Nourishment Requirements

The results of the simulations run over multiple nourishment cycles provided the information necessary to estimate the nourishment volumes. The model produced results showing the expected volume losses with the recommended project during a 3-year renourishment cycle. These volumes served as input to the GRANDUC model as target annual erosion volumes over the project life. Model results support an average 3-year nourishment volume of 1,055,000 cubic yards for the North Project and 2,835,000 cubic yards for the South Project. Actual 3-year nourishment volumes will vary from cycle to cycle and periodic field surveys will determine actual nourishment needs.

6.02.3 Transition Requirements

The GENESIS model simulations were used to investigate a range of transition lengths at the project boundaries. Transitions are used to minimize project "end losses" resulting from increased sediment transport off of the beach-fill due to the offset in the shoreline between the natural and man-made beach.

The initial model runs indicated that the overall project performance increased with increasing transition length, as the longer transition zones served to "pre-fill" the adjacent beach areas. In practice, the transition length is limited by the cost of placing the additional volume of sediment in the transition areas and/or by the practical construction limitation of placing a very long thin tapering fill along the beach. A further consideration is that as the project undergoes additional nourishment cycles, less expensive transitions are typically required as more sediment is dispersed from the main fill to the adjacent areas. Given the above considerations, additional model runs were accomplished covering four nourishment cycles using transition lengths of 1,000 and 3,000 feet. At the end of each cycle, the performance of the beach-fill was assessed and nourishment material was added non-uniformly along the project reach in anticipation of the beach response over the next three years. In each case no additional material was placed beyond the 1,000 or 3,000 foot transition limits. Overall, the beach-fill response was similar for each case, however the 3,000 foot transition length resulted in less total fill volume over the four nourishment cycles for both the North and South Project areas. This being the case, the recommended transition length for all project transitions is 3,000 feet.

6.02.4 Impacts on Cape Hatteras National Seashore

A proposed 3,000 foot transition is included as part of the project design. This transition will not extend into the National Seashore along the southern reaches of the South Project as previously proposed since the National Park Service declined to provide a special use permit for this area. The shoreline modeling shows that the beach-fill placed within the project boundaries can be expected to spread into the National Seashore for about 9,000 feet beyond the transition (which now ends at the Nags Head/National Seashore boundary) under average wave conditions. The impact of this sand transport is not expected to be significantly different from background sand transport impacts on biological resources.

6.02.5 Maintenance at Oregon Inlet

Model investigations revealed that a minor increase in net southerly transport would result from fully excavating all offshore borrow areas during the 50-year project life. The project as presently formulated is expected to remove about 70% of the available borrow volume by the end of the 50-year project life, therefore model results using 100% removal of borrow material represent a worse case. Under this condition, an approximate 13% increase in maintenance dredging could result at Oregon Inlet or about 65,000 cubic yards per year. Since 1983, when intensive

hopper/pipeline dredging of the inlet was resumed, an average of 490,000 cubic yards has been dredged annually but the yearly dredged quantity has varied greatly from zero to more than 1,100,000 cubic yards with a standard deviation of 320,000 cubic yards per year. Given this wide range in dredging, the possible increase in maintenance dredging is well within the historical variation under the worst case condition. Annual increases in dredging costs at Oregon Inlet are projected to be approximately $3,000 based on the 65,000 cubic yards that has been projected for project year 50. Inclusion of this cost does not change the overall project benefit to cost ratio. Since this cost, which would fall within the normal cost contingencies for the project, has no impact on project selection, and is minor in magnitude (compared to historical variations), it's inclusion as a project cost does not appear to be warranted.

6.03 Socioeconomic Resources

The NED plan alternative would have beneficial impacts on socioeconomic conditions through greater protection and potential for reducing damages provided by the beach erosion control and hurricane wave protection project. A considerably larger expanse of beach available during both high and low tidal conditions would be far more attractive to tourists who provide the basis for the local economy. The benefit-to-cost ratio for the NED plan is 1.9 to 1.0.

6.04 Marine Resources

6.04.1 Dredging Impacts

Monitoring studies of post construction borrow areas in the southeast indicate that borrow areas can fill in and return to near predredging conditions when there is adequate transport of sediment under the influence of strong currents in the area (Bowen, P.R. & G.A. Marsh, October 1988). The selected borrow areas are located in waters with depths between -30 and -60 feet msl. The average depth of dredging in each borrow area would be approximately 9 feet below the existing bottom elevation in N1 and 12 feet in S1. Currents in the area are expected to contribute to some filling of the borrow site with material from sloughing of undisturbed areas adjacent to the construction sites; however, it is expected that the modified bathymetry of the sites will persist.

Dredging in the selected borrow areas should not have an adverse impact on any hardbottoms in the area. Based on magnetometer and side-scan sonar survey of the selected borrow areas, there was no indication of any hardbottoms within the areas surveyed. A study of nearshore borrow areas after dredging offshore of South Carolina revealed no long-term impacts to fishery and planktonic organisms, as a result of the dredging (Van Dolah et al 1992).

Impacts to anadromous fish and other estuarine-dependent organisms are not expected to be significant since construction-related activities in the offshore borrow

areas and on beaches proposed for nourishment would be localized, and over 4 miles away (at the closest point) from Oregon Inlet.

Impacts associated with dredging methods may differ depending on type of dredge and associated equipment used. Dredging impacts on benthic invertebrates would be similar, since the sediment surface where the organisms are found would be removed with an associated loss of all inhabitants under all scenarios. A hopper dredge takes a shallower and wider cut that may impact a larger surface area during a given event. Since a hopper dredge drag head operates at or above the bottom surface and pipeline cutterhead would be operated below the sediment surface the ability of benthic fish to avoid the dredge may be different. Methods that use scows include associated risks of collision with marine mammals, which are not a concern for scenarios that do not. Methods that use pipelines to transport dredged material may have temporary impacts to any benthic organism covered by the pipeline and reduced access to trawlers. The environmental differences are considered insignificant.

6.04.2 Entrainment Impacts

Any entrainment of adult fish, and other motile animals in the vicinity of the borrow area during dredging is expected to be minor because of their ability to avoid the disturbed areas. Fish species are expected to leave the area temporarily during the dredging operations and return when dredging ceases (Pullen and Naqvi, 1983). Larvae and early juvenile stages of many species pose a greater concern than adults because their powers of mobility are either absent or poorly developed, leaving them subject to transport by tides and currents. This physical limitation makes them potentially more susceptible to entrainment by an operating hydraulic or hopper dredge. Organisms close to the dredge cutterhead or draghead may be captured by the effects of its suction and may be entrained in the flow of dredged sediment and water. As a worst-case, it may be assumed that entrained animals experience 100 percent mortality, although some small number may survive. Susceptibility to this effect depends upon avoidance reactions of the organism, the efficiency of its swimming ability, its proximity to the cutterhead, the pumping rate of the dredge, and possibly other factors. Behavioral characteristics of different species in response to factors such as salinity, current, and diurnal phase (daylight versus darkness) are also believed to affect their concentrations in particular locations or strata of the water column. Any organisms present near the ocean bottom would be closer to the dredge cutterhead or draghead and, therefore, subject to higher risk of entrainment.

The biological effect of hydraulic entrainment has been a subject of concern for more than a decade, and numerous studies have been conducted nationwide to assess its impact on early life stages of marine resources, including larval oysters (Carriker et al., 1986), post-larval brown shrimp (Van Dolah et al., 1994), striped bass eggs and larvae (Burton et al., 1992), juvenile salmonid fishes (Buell, 1992), and Dungeness crabs (Armstrong et al., 1982). These studies indicate that the primary organisms

subject to entrainment by hydraulic dredges are bottom-oriented fishes and shellfishes. The significance of entrainment impact depends upon the species present; the number of organisms entrained; the relationship of the number entrained to local, regional, and total population numbers; and the natural mortality rate for the various life stages of a species. Assessment of the significance of entrainment is difficult, but most studies indicate that the significance of impact is low. Reasons for low levels of impact include: (1) the very small volumes of water pumped by dredges relative to the total amount of water in the vicinity, thereby impacting only a small proportion of organisms, (2) the extremely large numbers of larvae produced by most estuarine-dependent species, and (3) the extremely high natural mortality rate for early life stages of many fish species. Since natural larval mortalities may approach 99 percent (Dew and Hecht, 1994; Cushing, 1988), entrainment by a hydraulic dredge should not pose a significant additional risk in most circumstances. Neither direct quantification studies nor modeling efforts have demonstrated population level impacts due to larval entrainment by hydraulic dredges (memo of August 8, 1995 from Douglas Clarke, Ph.D., Coastal Ecology Branch, Waterways Experiment Station, USACE, Vicksburg).

A dredge operating in the open ocean would pump such a small amount of water in proportion to the surrounding water volume that any entrainment impacts of dredging of borrow material for the Dare County Beach project are expected to be insignificant.

In summary, only a very small percentage of marine and estuarine larvae are subject to entrainment, so dredging conducted as part of the proposed action is not expected to create significant impacts on these life forms at local or regional population levels.

6.04.3 Commercial and Recreational Fisheries

NCDMF letter dated August 15, 2000 indicates that *"Extensive recreational fisheries occur in the surf, as well as hook and line fishing from fishing piers and private and charter boats along the entire project area and in the borrow areas. Traditional commercial fisheries in the project area include beach seines, gill netting and trawling."*

During project construction and maintenance there will be an increase in the turbidity of the surf zone in the immediate area of sand deposition. Most of the fine material in the beachfill is expected to be washed seaward into the surf zone during construction and maintenance. This increase in fine material may cause the temporary displacement of various species of fish, causing a negative impact to surf and pier fishing and beach seining in the area of deposition. A study done by the NMFS on the effects of beach nourishment on nearshore macroinfauna concluded that beach nourishment projects using offshore dredged material have no harmful effects provided that the sediments are similar to those where they are placed (Saloman and Naughton 1984). The material that would be used for beachfill is

similar in composition to the native beach material.

Beach disposal will proceed up or down the beach progressing at a slow rate of about ½ to 1 mile a month. Fishing activities will be precluded from the immediate vicinity of the discharge during construction and maintenance. Portions of the project area that have been recently completed and those awaiting disposal would be accessible for fishing. The immediate construction area is small relative to nearby available fishing areas that could be accessed by numerous beach access points located throughout the project area. Pipelines along the beach that cross established vehicle access points would be ramped as practical to facilitate continued use.

Four of the five ocean piers in the project area are within the proposed fill area. The proposed project would move the shoreline under these piers seaward, potentially reducing available fishing area. A seaward movement of up to about 150' -200' would be expected assuming the initial construction profile. When the initial construction profile adjusts to recommended project cross section, the shoreline could be about 50-100 feet seaward of the preproject condition (see figure 3). Commercial trawlers would not be able to operate in the immediate vicinity of the dredge and any areas occupied by pipelines during construction and maintenance. Charter boats and recreational boaters may be required to alter their course to avoid the dredge. Pipelines and dredges would be buoyed and lighted per US Coast Guard requirements to reduce navigational hazards. Dredging is proposed to occur annually throughout the project life (50 years). No permanent placement of equipment is proposed. Only a limited area of open ocean would be occupied by equipment in relation to available fishing areas and maintenance dredging would only occur during a portion (generally, 15 November to 30 April) of any given year.

The fish catch in the project area is primarily pelagic species. The US Department of Interior Minerals Management Service (DOI 1999) provides the following information regarding dredging and disposal activities on these species of fish. *The pelagic/anadromous fisheries include those marine species that are free-swimming or highly migratory and therefore can avoid the areas of dredge activity. Direct impacts to this fishery could result from noise, entrainment, gill clogging, depletion of benthic food sources, and loss of relict shoal areas that may be utilized as navigation points for some migratory marine species (T. Goodger, NMFS, pers. comm., April, 1999). The importance of benthic communities in marine food webs leading to exploitable yields of pelagic and anadromous fish is widely recognized. Decimation of benthic community populations could result in a depletion of food source for the pelagic species (e.g., red drum, weakfish, silver hake) that rely on these organisms for sustenance (Newellet al. 1998a). Yet, the mobility of these fish species enables them to avoid the dredging operational areas and obtain food sources in other unaffected forage areas incurring insignificant adverse impacts to the fishery (T.Goodger, NMFS, pers. comm., April, 1999). There is also evidence that dredging operations may benefit fish species that feed within the water column by suspending food material (Courtenay et al. 1972). Bordering regions of dredge*

activity could provide suitable fishing grounds due to the resuspension of food particles. Spawning, egg dispersal, and juvenile development for these species occurs inshore and away from the study area resulting in minimal impacts to the stresses already imposed upon future stock abundance.

6.04.4 Essential Fish Habitat

The Fishery Management Plan Amendments of the South Atlantic Fishery Management Council identify a number of categories of Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC), which are listed in *Table 8*. While all 26 of these habitat categories occur in waters of the southeastern United States, many are absent from the project vicinity. Those absent include estuarine scrub/shrub mangroves which require a more tropical environment and several areas that are geographically removed from the project area including: Hoyt Hills located in the Blake Plateau area in water 450-600 meters deep, Cape Fear Sandy Shoals also known as Frying Pan Shoals, Big Rock and Ten-Fathom Ledge located off Cape Lookout, New River, and Bogue Sound. In addition, there are no Council-designated Artificial Reef Special Management Zones, Intertidal Flats, Oyster Reefs, and Shell Banks, Aquatic Beds, Wetlands or Seagrass beds in or near Dare County Beaches potential project impact area. Impacts on habitat categories potentially present in the project vicinity are discussed below.

6.04.5 Impacts on Cape Hatteras Sandy Shoal

A North Carolina habitat area of particular concern is Cape Hatteras (sandy shoals). This site is located about 40 miles south of the project area and would not be affected by the proposed action.

6.04.6 Impacts to the Point

The Point is located east of Cape Hatteras near the 200-meter contour, well offshore of the proposed project and would not be affected.

6.04.7 Impacts on Sargassum

Sargassum is pelagic brown algae, which occurs in large floating mats on the continental shelf, in the Sargasso Sea, and in the Gulf Stream. It is a major source of productivity in a nutrient-poor part of the ocean. Masses of *Sargassum* provide extremely valuable habitat for a diverse assemblage of animal life, including juvenile sea turtles, sea birds, and over 100 species of fish. Unregulated commercial harvest of *Sargassum* for fertilizer and livestock feed has prompted concerns over the potential loss of this important resource. While smaller clumps of this seaweed may float into the project area, it typically occurs much further offshore. In any case, since it occurs in the upper few feet of the water column, it is not subject to impacts from dredging or sediment disposal activities associated with the proposed action.

6.04.8 Impacts on Reef-forming Corals

Hermatypic, or reef-forming, corals consist of anemone-like polyps occurring in colonies united by calcium encrustations. Reef-forming corals are characterized by the presence of symbiotic, unicellular algae called zooxanthellae, which impart a greenish or brown color. Since these corals derive a very large percentage of their energy from these algae, they require strong sunlight and are, therefore, generally found in depths of less than 150 feet. They require warm water temperatures (68 to 82 F) and generally occur between 30^0N and 30^0S latitudes. Off the east coast of the United States, this northern limit roughly coincides with northern Florida. Although they occur off the North Carolina coast, they are not known within the immediate project vicinity, and they should not be affected by the proposed action.

6.04.9 Impacts on Artificial Reefs

The NCDMF lists 4 artificial reefs in the project vicinity. They are AR 130, AR 140, AR 145, and AR 160. The location of the closest sites AR 130 and AR 140 are shown on figure 2. All of these sites are located over 3miles off the beach. AR 140, located about 1mile west of S-1, is in the closest proximity to a borrow site.

Dredging conducted as part of the proposed action will not be done in close proximity to any of these artificial reefs, so no adverse impacts would occur. Disposal on the ocean beaches of Dare County will involve the discharge of high-grade sand (average sand content at least 90%) into the swash zone, and, likewise, will have no direct effect on these reef sites. Turbidity plumes may be produced by beach disposal as fine sediments are washed away by littoral processes. If such plumes are still detectable as far offshore as the NCARP reefs, their effects should be minor, temporary, and should quickly dissipate. Any reef located within two miles of the proposed borrow areas will be identified on project plan sheets as sensitive areas to be avoided during anchoring. The proposed action will not significantly impact any NCARP reefs.

6.04.10 Impacts on Hardbottoms

Sidescan sonar surveys of potential borrow areas did not identify hardbottom within any of the potential borrow sites. Collection of sediment core samples within potential borrow areas confirm absence of hardbottom within the borrow sites. Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP) identified one area of hardbottom and one area of potential hardbottom in the project vicinity as shown on Figure 4-2. These areas are located between proposed borrow area S1 and the beach at Nags Head. The sites identified by SEAMAP are located over a mile away from the nearest point of proposed borrow sites (S1, N1, and N2) and about 1 mile off the beach. SEAMAP transects include both positive and negative evidence of hardbottom in subsequent years. The hardbottom point was identified in 1972. The point has been the subject of 5 prior and 13 post surveys that did not identify hardbottom. Dr. Steve Ross of the National

Estuarine Research Reserve, (Pers.com. Nov. 16, 1999) indicates that designation of a hardbottom or potential hardbottom may be based on the presence of Black Sea Bass that occur on non-hardbottom, north of Cape Hatteras. Therefore this designation may be erroneous.

The borrow materials are predominantly sand and any sedimentation due to dredging would be localized to the immediate dredging area and would not be expected to impact adjacent areas. The potential hardbottom sites are located beyond the closure depth for the project and should be unaffected by disposal operations. Any turbidity impacts would be minor and temporary as described for artificial reefs above. The current status of the aforementioned hardbottom areas will be assessed by sidescan sonar prior to construction and maintenance and if present will be identified on construction drawings so they can be avoided and protected from physical impacts due to anchoring.

6.04.11 Impacts on State-designated Areas Important for Managed Species

Primary Nursery Areas (PNAs) are designated by the NC Marine Fisheries Commission and are defined by the State of North Carolina as tidal saltwater which provide essential habitat for the early development of commercially important fish and shellfish (15 NC Administrative Code 3B .1405). Many fish species undergo initial post-larval development in these areas. This project will not impact PNAs.

6.04.12 Impacts on the Marine Water Column

The potential water quality impacts of dredging and disposal are addressed in Section 6.07. Dredging and disposal operations conducted during project construction and maintenance may create impacts in the marine water column in the immediate vicinity of the activity potentially affecting the surf zone and nearshore ocean. These impacts may include minor and short-term suspended sediment plumes and related turbidity, as well as the release of soluble trace constituents from the sediment. During dredging, turbidity increases outside the dredging area should be less than 25 NTUs and are, therefore, considered insignificant. In the case of overflowing hopper dredges or scows to obtain economic loading, sediment which is more than 90 percent sand is not likely to produce significant turbidity or other water quality impacts (USACE, 1997). Overall water quality impacts of the proposed action are expected to be short-term and minor. Living marine and estuarine resources dependent upon good water quality are not expected to experience significant adverse impacts due to water quality changes.

Scientific data are very limited with regard to the effects of beach disposal on fishery resources. These effects may be similar, on a smaller scale, to the effects of storms; storm effects may include increased turbidity and sediment load in the water column and in some cases, changes in fish community structure (Hackney et al., 1996). Storms of great severity, such as hurricanes, have been documented to

create conditions resulting in fish kills, but such situations are not usually associated with beach disposal of dredged sand.

In a 1999 Environmental Report on the use of Federal offshore sand resources for beach and coastal restoration, the US Department of Interior Minerals Management Service provided the following assessment:

In order to assess if turbidity causes an impact to the ecosystem, it is essential that the predicted turbidity levels are evaluated in light of conditions such as during storms. Storms on the Mid-Atlantic shelf may generate suspended matter concentrations of several hundred mg/l (e.g., Styles and Glenn 1999). Concentrations in plumes decrease rapidly during dispersion. Neff (1981, 1985) reported that solids concentrations of 1000 ppm two minutes after discharge decreased to 10 ppm within one hour. Poopetch (1982) showed that the initial concentration in the hopper overflow of 3,500 mg/l decreased rapidly to 500 mg/l within 50 m. For this reason, the impact of the settling particles from the turbidity plume are expected to be minimal beyond the immediate zone of dredging.

Beach disposal of dredged sediments can affect fishery resources and EFH through increases in turbidity and sedimentation which, in turn, may create localized stressful habitat conditions, and may result in temporary displacement of fish and other biota. However, the sediment proposed for beach placement by the Dare County Beaches project would average 90 percent or more sand. Because of the low silt/clay content, water column impacts are expected to be localized, short-term, and minor. Furthermore, the beach disposal operation is expected to proceed at a slow rate. Mobile biota, including juvenile and adult fish, should be able to relocate outside the more stressful conditions of the immediate disposal operation. Cumulative effects of multiple simultaneous beach disposal operations could be potentially harmful to fishes of the surf zone. The high quality of the sediment selected for beach fill and the small amount of beach affected at any point in time would not suggest that this activity poses a significant threat; however the magnitude of the impact of beach disposal in the surf zone has yet to be determined. The unknowns concerning the occurrence, distribution, and life history aspects of surf zone fishes and their sensitivity to beach disposal impacts suggest that further study is warranted. The Corps has agreed to study these impacts at Brunswick County Beaches beginning in December 2000. It is expected that this effort in combination with project specific monitoring will be sufficient to resolve unknowns regarding this issue.

6.04.13 Impacts of Larval Entrainment

Life forms that lack the ability to escape the suction field of an operating dredge are subject to entrainment in the flow of water and sediment passing through its pumping equipment, and mortality is the likely result. However, only an extremely small percentage (a fraction of 1%) of the marine and estuarine larvae in the Atlantic Ocean are realistically subject to entrainment based upon the amount of water that a dredge can pump. Overall, the dredging to be conducted as part of the proposed

action is not expected to create significant impacts on these life forms at local or regional population levels. Additional information on entrainment impacts can be found in Section 6.04.2

6.04.14 Impact Summary for Essential Fish Habitat

The following NMFS EFH recommendations were provided by letter dated August 18, 2000. The recommendations are followed by a U.S. Army Corps of Engineers, Wilmington District (Corps) responses.

NMFS EFH Recommendation: Implementation of the project should be delayed pending completion of the studies to be funded by the Corps and the Engineering Research and Development Center. Completion of these studies will provide new information on the impact of beach nourishment in nearshore areas on early life history stages of federally managed species.

Corps Response: We do not plan to delay project implementation pending completion of the referenced studies. However, the aforementioned studies are expected to begin in 2001. The proposed project is not scheduled for implementation until 2004. It is expected that pertinent data will be available from these studies prior to project implementation. Project specific impact monitoring (not included in the DEIS) is now proposed. If significant unforeseen impacts are detected, a mitigation plan will be developed in coordination with appropriate resource agencies.

NMFS EFH Recommendation: To minimize the direct and indirect impact of turbidity, the Corps should ensure that the project does not use any sediment which consists of more than 10 percent silt or clay particles.

Corps Response: Our analysis indicates that all proposed borrow sites meet this requirement. The sand compatibility between N1 and the proposed North Project Area beach construction site are less than those of S1 with a 1.5 overfill ration versus 1.1. However, both sites proposed for use, N1 and S1, were found to meet the <10 percent silt criteria (about 9 percent and 5 percent silt respectively). Both sites are considered acceptable for dredging and beach disposal.

NMFS Comment: The project plans described in the DEIS should be revised to avoid impacts to overwintering habitat for the federally managed spiny dogfish and summer flounder by eliminating dredging in site N1 and limiting dredging for borrow material to site S1 or another site with similar sand content and low fishery value.

Corps Response: An alternative that does not use N1 will be evaluated in the FEIS. Our preliminary evaluation of this alternative indicates that this would increase the initial construction cost of the North project by a minimum of about $13,000,000. This action is not expected to provide a significant reduction in project impacts and therefore is not proposed.

The surface area of N1 that is proposed for use (300 acres), is a very small portion of a much larger geographic area that extends from about Nova Scotia to Cape Hatteras, North Carolina, and is considered wintering grounds for these species (see enclosed seasonal distribution maps from NMFS EFH source documents for spiny dogfish and summer flounder). While we agree that these species may be present, we are not aware of data that suggests any particular affinity to N1 by spiny dogfish or summer flounder. Considering the distribution of these species, the use of N1 as a borrow site does not represent a substantial threat to spiny dogfish or summer flounder populations.

The proposed action is not expected to cause any significant adverse impacts to Essential Fish Habitat of EFH species. However, the magnitude of the impact of beach disposal in the surf zone has yet to be determined.

6.04.15 Impacts on Nearshore Ocean Invertebrates

Benthic organisms in areas dredged for construction and maintenance will be lost. However, recolonization by opportunistic species is expected to begin soon after the dredging activity stops. Rapid recovery is expected from recolonization from migration of benthic organisms from adjacent areas and by larval transport. Some changes in species composition and population may occur. The infilling rate and the quality of the material would be factors in the recovery of the area dredged. Monitoring studies of post dredging effects and recovery rates of borrow areas indicates that most borrow sites usually show significant recovery by benthic organisms approximately 1 to 2 years after dredging (Naqvi and Pullen, 1982, Bowen, at al. 1988, and Van Dolah et al 1992). Some infilling from sedimentation and sloughing of bottom substrate from surrounding areas is expected, however some change in bottom contour may be evident throughout the project life and post construction populations may differ from pre-construction conditions.

In a 1999 Environmental Report on the use of Federal offshore sand resources for beach and coastal restoration, United States Department of Interior Minerals Management Service provided the following assessment of potential turbidity impacts.

The impacts from turbidity on benthic organisms during dredging operations were reviewed in detail by Pequegnatet al. (1978) and Stern and Stickle (1978). Both studies concluded that impacts to the benthic populations of the marine ecosystem from turbidity are local and temporary but not permanent. Similarly, recent studies show that benthic impacts may be limited to the immediate vicinity of dredging operations (e.g., Hitchcock et al. 1998;MMS 1996).

6.04.16 Impacts on Beach Invertebrates

Beach disposal of dredged material may have negative impacts on intertidal macrofauna through direct burial, increased turbidity in the surf zone, or changes in

the sand grain size or beach profile. Some previous disposal operations have resulted in nearly complete localized mortality of intertidal macrofauna (Reilly and Bellis, 1978) while others involving disposal of coarse sand have caused only temporary shifts in population distribution that are believed to represent only minor impacts (Hayden and Dolan, 1974).

Short term, reoccuring impacts on intertidal microfauna in the immediate vicinity of the beach nourishment project are expected as a result of discharges of nourishment material on the beach. Any reduction in the numbers and/or biomass of intertidal macrofauna present immediately after beach disposal may have localized limiting effects on surf-feeding fishes and shorebirds due to a reduced food supply. In such instances, these animals may be temporarily displaced to other locations.

Reilly and Bellis (1978) stated, "Beach nourishment virtually destroys existing intertidal macrofauna; however, recovery is rapid once the pumping operation ceases. In most cases, recovery should occur within one or two seasons following the project completion." Similar findings were reached by Van Dolah (1992) in a study of the impacts of a beach nourishment project in South Carolina. A study by Dolan et al. (1992) of the effects of beach fill activities on mole crabs at the Pea Island National Wildlife Refuge, Dare County, North Carolina, indicates that while nourishment has a dramatic impact on mole crabs in the area where beachfill is placed, mole crabs returned to the beach areas that were nourished soon after pumping stopped. The borrow areas for the project are located seaward of the wintering areas for these organisms therefore dredging in the borrow areas should not impact intertidal invertebrates.

While beach disposal may produce negative effects on intertidal macrofauna, these are localized in the vicinity of the disposal operation. Beach disposal conducted as a component of the proposed action could occur year-round during construction, but would be expected to move along the beach at a relatively slow rate. This rate of progress is slow enough that surf-feeding fishes and shorebirds may move to other areas that are not affected by the disposal operation. Also, this rate of progress would mean that only a few consecutive miles of beach would be affected during any season of the year. As the dredging operation passes by a given section of beach, that area is soon available for recolonization by invertebrates.

After initial construction of the Dare County Beaches project is complete, subsequent sand placement on beaches for periodic nourishment would be conducted, to the maximum extent practicable, during the November 16 - April 30 window established for the protection of nesting sea turtles. This seasonal sand placement would also be less disruptive of the invertebrate community of the intertidal zone. Subsequent disposal operations for a given beach phase would reverse the starting point and proceed in the opposite direction to further reduce seasonal impacts to a given reach of beach.

In a 1999 Environmental Report on the use of Federal offshore sand resources for beach and coastal restoration, U. S. Department of Interior, Minerals Management Service provided the following assessment of potential impacts to beach fauna from beach disposal.

As with benthic organisms living in borrow areas, benthic organisms are significantly impacted by beach nourishment activities (Nelson 1985; Van Dolah et al. 1992). These impacts, however, are considerably shorter in duration than the impacts observed in offshore borrow areas. Because benthic organisms living in beach habitats are adapted to living in high energy environments, they are able to quickly recover to original levels following beach nourishment events; sometimes in as little as three months (Van Dolah et al. 1994; Levison and Van Dolah 1996). This is again attributed to the fact that intertidal organisms are living in high energy habitats where disturbances are more common. Because of a lower diversity of species compared to other intertidal and shallow subtidal habitats (Hackney et al. 1996), the vast majority of beach habitats are recolonized by the same species that existed before nourishment (Van Dolah et al. 1992; Nelson 1985; Levison and Van Dolah 1996; Hackney et al. 1996).

While the proposed beach disposal will adversely impact intertidal macrofauna, these effects will be localized, short-term, and reversible.

6.04.17 Nearshore Ocean Birds

Sea ducks or other birds using ocean borrow areas would be temporarily displaced during dredging operations for construction and maintenance. Due to depth in these sites (30'-60'), they are not expected to provide a benthic food source. Congregation or rafting of sea ducks in these areas is primarily for loafing (Pers. com. Bob Nofsinger, DOI). It is expected that since the area of ocean disturbed is small when compared to available loafing areas, any impacts would be minor.

6.05 Terrestrial Resources

Project construction and maintenance is not expected to have an adverse impact on wildlife found along the beach or that utilizes the dune areas. Project construction will result in disturbance and removal of some of the existing vegetation along the seaward side of the existing dune. Project construction, however, would be followed by measures designed to stabilize the constructed dunes. Dune stabilization would be accomplished by the vegetative planting of the dune during the optimum planting seasons and following the berm and dune construction. Planting stocks shall consist of sea oats and American beachgrass. The vegetative cover shall extend from the landward toe of the dune to the seaward intersection with the storm berm for the length of the dune. American beachgrass will be the predominant plant with sea oats as a supplemental plant. Planting would be accomplished during the season best suited for the particular plant. Maintenance of the project would involve placing

material along the berm. Therefore, minimal impacts to dune vegetation should occur.

6.06 Recreational and Aesthetic Resources

Expansion of the beach area would improve recreational quality for beach users. Recreation benefits for the NED alternative would result from increased quality of the recreation experience. The aesthetic quality of Kitty Hawk, Kill Devil Hills and Nags Head Beaches would be impacted by the noise and visual intrusion of the dredge and associated pipes and equipment during construction and maintenance of the project; however, the presence of such equipment will be periodic and temporary.

Four ocean piers are within the construction area. They are Outerbanks, Jennette's, Avalon and Nags Head. As described in section 6.05, the placement of beach fill under these piers may reduce the area available for fishing. Disposal during the fishing season may also impact the recreational catch. During past projects at Wrightsville Beach and Carolina Beach, no special provisions were made during placement of beach-fill around the piers and no major objections were raised during the process. However, for Atlantic Beach during the pumpout of Brandt Island, the beach-fill was wider than usual, thus raising concerns from fishing interests. The Dare County project is similar to the Wrightsville and Carolina Beach projects. The depth of material under the piers will generally be increased by only 1 to 2 feet during offshore migration in the active zone, which extends roughly 2000 seaward of the shoreline. Any turbidity that may occur during placement will be dissipated during several tidal cycles and should have no significant long-term impact on fishing from either the pier or the surf zone. These impacts are not expected to significantly reduce public use at any of the affected piers.

6.07 Water Quality

Dredging in the selected borrow areas would involve mechanical disturbance of the bottom substrate and subsequent redeposition of suspended sediment and turbidity generated during dredging. Factors that are known to influence sediment spread and turbidities are grain size, water currents and depths. Monitoring studies done on the impacts of offshore dredging indicate that sediments suspended during offshore are generally localized and rapidly dissipate when dredging ceases (Naqvi and Pullen. 1984, Bowen and Marsh.1988, and Van Dolah et al. 1992). Some infilling of the borrow area after dredging is expected from side sloughing of native bottom sediments which consist of predominately sandy material with a small amount of fine or organic material.

During construction, there will be elevated turbidity and suspended solids in the immediate area of sand deposition when compared to the existing non-storm conditions of the surf zone. Significant increases in turbidity are not expected to occur outside the immediate construction/maintenance area (turbidity increases of 25 NTU's or less are not considered significant). Turbid waters (increased turbidity

relative to background levels but not necessarily above 25 NTU's) will hug the shore and be transported with waves either northeast or southwest depending on wind conditions. Due to the low percentage of silt and clay in the borrow areas (<10 percent), turbidity impacts are not expected to be greater than the natural increase in turbidity and suspended material which occurs during storm events. Any increases in turbidity in the borrow areas during project construction and maintenance are expected to be temporary and limited to the area surrounding the dredging. Turbidity levels are expected to return to background levels in the surf zone upon cessation of dredging.

The proposed offshore dredging and placement of fill on the beach will not impact ground water resources in the study area.

A Section 401 (P.L. 92-500) Water Quality Certificate is being requested from the State Division of Environmental Management since the discharge of dredged material will be into waters of the United States. The impacts associated with the discharge of fill material into waters of the United States are discussed in the Section 404(b)(1) (P.L. 95-217) evaluation (Attachment A). Discharges associated with dredging in the offshore borrow areas are considered incidental to the dredging operation, and therefore, are not being considered as a discharge addressed under the Section 404 (b)(1) evaluation.

6.08 Cultural Resources

Pursuant to provisions of the Abandoned Shipwreck Act of 1987 and Section 106 of the National Historic Preservation Act, the U.S. Army Corps of Engineers, Wilmington District, has consulted with the Underwater Archaeology Unit of the North Carolina Division of Archives and History in conducting maritime research related to the project area of effects. In consideration of the large number of known vessel losses, shipwreck sites, and beachfront debris locations, a remote sensing and visual pedestrian survey was initiated by the Wilmington District. During the summer of 1997 and fall of 1998, maritime archaeologists from Mid-Atlantic Technology and Environmental Research, Inc., conducted magnetic and side-scan sonar survey of the offshore borrow area alternatives. The same firm also conducted visual survey of the beach renourishment area. These surveys resulted in negative findings and a recommendation of clearance for the proposed project. However, in recognition of the frequent and transient occurrence of shoreline wreckage, the Wilmington District and the Underwater Archaeology Unit will be conducting a visual beachfront survey of the renourishment area within four months of the initiation of project construction. This will assure that any recently dislodged or uncovered wreckage is recorded prior to being buried or removed from the beach. Any discovered wreckage to be left on the beach will be flagged so that heavy equipment and pipeline routing can avoid it. All work will be conducted in coordination with the North Carolina Division of Archives and History per provisions of the National Historic Preservation Act.

6.09 Threatened and Endangered Species

Under Section 7 of the Endangered Species Act of 1973, as amended, Federal agencies have a responsibility to assess the effects of their proposed actions on listed species. A separate biological assessment (BA) will not be prepared for the Dare County Beaches project. This DEIS will serve as the project BA and as a request to both the USFWS and the NMFS for their concurrence with our No Affect determinations and to request biological opinions for species that may be affected. The Corps' Biological Assessment of anticipated project impacts is as follows.

6.09.1 Right Whale

Hopper dredges and other vessel traffic can pose a collision threat to nearshore right whales during operation. Pipeline dredges, being essentially stationary, pose no collision threats. All commercial hopper dredges working in the project area are required to have trained observers on board during periods of whale migrations. If whales are spotted, the vessels reduce speed, and alter course as necessary until the whales have left the project vicinity. Since habitat conditions and food supplies will be maintained, and appropriate collision avoidance measures implemented, it has been determined that construction, operation and maintenance of the project is not likely to adversely effect the right whale.

6.09.2 Finback Whale, Humpback Whale, Sei Whale, and Sperm Whale

Collision avoidance measures, as described under the discussion of the right whale, above, also protect any nearshore members of these species. Productivity of the nearshore ocean will not be diminished; therefore, the food supply of these species should be unaffected. Since existing habitat conditions and food supplies will be maintained, and appropriate collision avoidance measures implemented, it has been determined that construction, operation and maintenance of the project will not affect the above listed species of whales.

6.09.3 Florida Manatee

While the Florida manatee has been reported from the project area in prior years, there is no way of predicting its occurrence there again during any given time period. It can only be assumed that the likelihood of it occurring in the area is very low. Beach nourishment, by pipeline dredges, should not significantly affect valuable food resources for the species nor pose any direct threat to the species because of the essentially stationary nature of the dredge plant. Hopper dredges are slow moving vessels (2 to 3 miles per hour) which generate considerable noise. It would be expected that, should a manatee occur in a borrow site being dredged by a hopper dredge, it would avoid the vicinity of the dredge boat and its dragheads. Due to its rare occurrence in the area and the slow moving nature of the dredges which would be used in maintaining the project, it has been determined that the construction and maintenance of proposed project is not likely to adversely affect the manatee.

6.09.4 Arctic Peregrine Falcon

The beach/dune complex habitat, most heavily used by migrating peregrines, will be stabilized by the project. The project should not significantly diminish the availability of shorebirds, the primary food source for the peregrine in the area. Due to the transient nature of the peregrine population in the project area, the limited extent of the project, and the continued availability of an adequate shorebird population, it has been determined that the construction, operation and maintenance of the project will not affect the species.

6.09.5 Bald Eagle

As stated previously, there are no known roosting or nesting areas within the immediate project area. The species feeds principally on fish and is, therefore, dependent on fisheries management and water quality sufficient to maintain an adequate forage base. It is expected that the availability of prey fishes should not be significantly affected. For these reasons, it has been determined that constructing, operating, and maintaining the project as currently proposed is not likely to adversely affect the bald eagle.

6.09.6 Piping Plover

The piping plover is known to occur sporadically on the beaches of the project area. As indicated in Section 5.09, the species is not known to nest on project beaches proposed for nourishment. The presence of the project will alter the existing beach profile and configuration that will, in turn, change the feeding areas used by the piping plover. This accreted beach may attract increased numbers of visitors (including fishermen) to the beach, which will have the effect of further discouraging use by the species.

Beach nourishment could extend into the piping plover nesting season (April 1 through July 31). However, direct loss of nests from placement of sand should not occur since the species is not known or expected to nest in the area. Disruption of piping plover foraging habitat may result from placement of sand on the beach during the breeding season and the fall and winter. Piping plover foraging distribution on the beach may be altered since beach food resources may be affected by disposal operations. Food resource disruptions should be temporary and of minor significance. While any impacts to piping plovers are expected to be minor, they cannot be avoided. Therefore it has been determined that the project may affect the piping plover.

6.09.7 Roseate Tern

Construction, operation, and maintenance of the project will not affect any nesting areas for this species and will not significantly affect the fishery resources upon

which it depends during migratory periods. For these reasons it has been determined that the project will not affect the roseate tern.

6.09.8 Hawksbill, Leatherback, and Kemp's Ridley Sea Turtles

Beach nourishment with pipeline dredges should not affect any of these species of sea turtles, as pipeline dredges are not known to take sea turtles and none of these species nests in the project area. Hopper dredges may also be used for initial construction but is most likely to be used for periodic nourishment. If hopper dredges are used for construction, this project may affect these species, since this equipment is known to take sea turtles. It is proposed that any hopper dredging, conducted for periodic nourishment would be performed under a Regional Biological Opinion (RBO) issued by the National Marine Fisheries Service for hopper dredging in the southeastern United States. All provisions of this RBO, or any issued subsequently, will be strictly followed.

6.09.9 Loggerhead and Green Sea Turtles

The primary means by which the project would affect these species would be through alteration of their nesting habitat. During project construction material would be placed on the beach during the summer months. This may cause direct impact to nesting sea turtles. Since beach disposal for periodic nourishment of the proposed project would occur primarily during the fall and winter months, the effect on nesting sea turtles would be reduced.

Any beach disposal operations begun before 16 November of any given year will require prior nest monitoring and nest relocation in order to assure that the area to receive sands is clear of incubating sea turtle nests. Additionally, any beach disposal operations extending into the spring (past April 30) will also require implementation of a nesting monitoring/relocation program. As indicated previously, every effort will be made to conduct periodic nourishment operations for the proposed project outside of the normal nesting season for sea turtles and piping plovers; however, such encroachments may be necessary at times due to storms, equipment failure and delay, or other unforeseen reasons.

Due to the large scale of this project, avoiding the sea turtle nesting season during construction would increase the project cost by about $14.5 million, or about 21 percent, for additional mobilizations and increased dredging costs. This would also extend the construction period from 3 years to 6 years. We believe this is impractical and propose a construction schedule that would use up to 3 mobilizations beginning after the previous nesting season is over (November 15) and continue until complete, requiring beach disposal during the sea turtle nesting season that begins on May 1.

The beach disposal area is at the Northern extent of the sea turtle nesting range, historic numbers are low (from 0-6 nest per year) for the project area. Sea turtle

nest monitoring and relocation would minimize any impacts. The sea turtle nesting season would be avoided during maintenance so any impacts would be temporary (generally limited to the 3 year construction period) and localized to the segment of beach where disposal occurred during nesting season. However past performance at other North Carolina beaches indicates that encroachment into the nesting season will eventually occur during maintenance. As indicated above, during construction or whenever this possibility becomes evident, a standardized nest monitoring and relocation plan will be implemented. This plan incorporates monitoring of the construction area each morning from the beginning of the nesting season, or 90 days prior to anticipated sand placement, until the end of beach disposal operation (after all equipment is removed from the beach) and the relocation of any nests laid within the limits of the disposal operation. Using standard nest relocation techniques, all nests will be located to a suitable nursery beach, agreed to prior to the start of any relocation effort by the U.S. Fish and Wildlife Service and the North Carolina Wildlife Resources Commission. Hatching success of relocated nests will be monitored and reported. By these methods, the possibility of a sea turtle nest being inadvertently buried by beach nourishment will be minimized.

After placement of dredged material during construction and each nourishment event and prior to the first turtle-nesting season, the beaches will be monitored for compaction by the Corps. If the beach hardness exceeds 500 cone penetrometer units, the beach will be tilled. The details of such beach monitoring and tilling work are currently being discussed by the Corps, USFWS, and the southeastern states on a regional basis. Once a regional agreement is achieved, the Corps will abide by all of the provisions of the agreement.

Dredging in offshore borrow areas may temporarily remove food resources from the ocean bottom. Dredging impacts on the foraging habitat available in the project area will be minor since they will be very limited in relation to availability of similar ocean bottom foraging habitat.

The use of pipeline dredges should not affect either of these species, as pipeline dredges are not known to take sea turtles. Hopper dredges may also be used for initial construction, but are most likely to be used for periodic nourishment. If hopper dredges are used for construction, this project may affect these species, since this equipment is known to take sea turtles. It is proposed that any Hopper dredging, conducted for periodic nourishment would be performed under a Regional Biological Opinion (RBO) issued by the National Marine Fisheries Service for hopper dredging in the southeastern United States. All provisions of this RBO, or any issued subsequently, will be strictly followed.

Beach disposal will occur during the nesting season for project construction and encroaching into the nesting season for maintenance disposal operations would occur. Because of the possibility of missing a sea turtle nest during the nest monitoring program or inadvertently breaking eggs during relocation, it has been

determined that the recommended project may affect both the loggerhead and green sea turtles.

6.09.10 Shortnose Sturgeon

Pollution and over fishing are generally considered to be the principal causes of the decline of this species. The recent prohibition on taking any species of sturgeon less than 3 feet in length will help to protect the shortnose sturgeon from commercial and recreational fishing pressure. The proposed project will affect nearshore ocean and habitat that is in the immediate vicinity (over 4 miles away) of Oregon Inlet. This species is considered riverine and its occurrence in the project impact area is not expected. For this reason, we have determined that the project will not effect the shortnose sturgeon.

6.09.11 Seabeach Amaranth

Seabeach amaranth is an annual or perennial plant that usually grows between the seaward toe of the dune and the limit of the wave uprush zone. Greatest concentrations of seabeach amaranth occur near inlet areas of barrier islands, but in favorable years plants may occur away from inlet areas. It is considered a pioneer species of accreting shorelines and stable foredune areas. In general, placement of dredged material can result in alterations of beach profile and can bury either plants or seeds depending on the period when the work is performed. On the surface, the impacts of such actions on the species would appear to be clearly adverse. However, an examination of seabeach amaranth distribution indicates that the species thrives in many frequently used beach disposal sites, possibly because the disturbance generated by disposal actions mimics the natural disturbances found in its preferred habitat. The net result is a picture that is by no means clear but would seem to illustrate that habitat maintenance, rather than maintenance of individual plants, is of overriding importance to the species.

Surveys conducted by the Corps in September 1997 and July 1998 did not identify any populations of seabeach amaranth in the project area. Since beach nourishment could result in burial of any future plants that may colonize the area, surveys of the project area will be conducted prior to any disposal operation. There is a low probability that *ameranthus* would be found prior to construction due to eroded site conditions and a project location that is several miles away from the inlet overwash area that is the preferred habitat. If *ameranthus* were found within the construction or maintenance impact area, Section 7 coordination with USFWS would be reinitiated.

Based on the absence of the species in the project area we have determined that the project would not effect seabeach amaranth.

6.10 Other Significant Resources (Section 122, P.L. 91-611)

a. Air, Noise, and water pollution: Air pollution will be created by construction equipment; however, the pollution produced is no worse than that from any other large piece of machinery and should be readily dispersed. Noise from construction equipment is slightly out of character for some of the project area; however, construction sounds will be readily attenuated by background sounds from wind and surf. Water quality impacts are discussed in Section 6.07 and in the Section 404(b)(1) (P.L. 95-217) evaluation included with this document as Attachment 1.

b. Man-made and Natural resources, Aesthetic Values, Community Cohesion, and the Availability of Public Facilities and Services: Beach nourishment will require the extension of dune crossover structures along the beach. Existing DOT storm drainage pipes will have to be extended to the shoreward crest of the newly constructed dune. Dredging in the offshore borrow areas is not expected to cause significant interference with commercial and recreational boat traffic. The mobility of a hopper dredge will preclude any interference with regular commercial ship traffic as a result of travel to and from the borrow areas. Should a hydraulic pipeline dredge be used, the pipeline from the borrow area to the disposal beach will be submerged until it reaches nearshore waters. The pipeline would be marked to let commercial and recreational boaters know of its presence along the bottom. Work barges and other appurtenances associated with a pipeline dredge operating in open water would be moored so as to minimize interference with boat traffic in the area.

Impacts to aesthetic values are discussed in Section 6.06. Impacts to natural resources are discussed in Sections 6.01. Impacts to cultural resources are discussed in Section 6.08. Hurricane protection and beach erosion control will benefit numerous roads, business, and residences. The NED alternative will have beneficial effects on community cohesion and will protect many public facilities and services (i.e. roads and utilities) from storm events.

c. Employment, Tax, and Property Value: No adverse effects on employment, tax, and property value are expected as a result of implementation of the NED plan alternative. Some temporary jobs may be available during construction and maintenance operations. Any ocean front homes that are currently taxed at a reduced rate due to high erosion could return to full taxation with the project in place.

d. Displacement of People, Businesses, and Farms: There are improvements that will be affected by the proposed project. The NED plan includes the acquisition of 8 homes, one swimming pool, and one outbuilding. There will be no utility relocations and there are no existing

Federal projects within the acquisition area. The proposed plan for this project requires PL 91-646 assistance. There are eight dwellings that are impacted by this alternative, all of which are seasonal residences, therefore only moving expenses will be payable on these relocations. No businesses or farms will be displaced by the NED alternative; however, some of the acquired dwelling homes may provide rental income.

e. Community and Regional Growth: An increase in the growth rate of affected beach communities is not expected as a result of the NED plan alternative. The presence of a beachfill project on the beach will enhance the quality of the recreational experience for both residents and tourists. Tourism is an industry vital to the region's economy. Existing beachfront real property and that which occurs as growth continues will be protected.

6.11 Cumulative Impacts

The Council on Environmental Quality (CEQ) defines cumulative impact as

the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. 40 CFR 1508.7

This assessment of cumulative impacts of the proposed action will first focus on impacts of dredging from the proposed ocean borrow sites, and second on impacts of placement of sand material on the beach.

In making this assessment, we have reviewed an Environmental Report prepared for and published by the U. S. Department of the Interior, Minerals Management Service, entitled "Use of Federal Offshore Sand Resources for Beach and Coastal Restoration in New Jersey, Maryland, Delaware, and Virginia," dated November 1999 (DOI 1999). In discussing the potential cumulative impacts of dredging operations for beach nourishment, we consider time crowded perturbations, and space crowded perturbations, as defined below, to be pertinent to this action.

- ***Time crowded perturbations*** *– repeated occurrence of one type of impact in the same area;*
- ***Space crowded perturbations*** *– a concentration of a number of different impacts in the same area;*

6.11.1 Dredging Impacts.

With dredging offshore areas for beach nourishment sand, there is a concern for potential cumulative impacts as a result of repeated dredging in a borrow area within short periods of time such that the benthic community, in particular, may not have sufficient time to recover. Dredging in subsequent areas close to one another may

result in impacts to potential adult recruitment to the dredged area, further lengthening recovery time (DOI 1999).

Site Specific Impacts: Concept plans for potential use of N1 and S1 borrow sites for project construction and maintenance are shown on Figures 4-2 and 4-3. Under the proposed plan the N1 Borrow Area (800 acres available) would be used one time only for construction of the North Project Area. Only a portion of the available area would be dredged for project construction and maintenance, directly impacting about 300 acres of sandy ocean bottom. The impacts of this activity on ocean invertebrates are discussed in section 6.04.15. The N1 site is remote to S1 (see figure 4-1) and would be unaffected by future activities at that site, therefore no cumulative impacts from time crowded perturbation would occur in N1 under the proposed plan. Assuming that the borrow area is not impacted by continued dredging, unusually high sedimentation rates, or some other disturbance, a natural succession of species composition should occur, potentially restoring the area to its original levels of abundance and biomass within 1-5 years (DOI 1999).

Comment 7.02 Attachment C, from the Town of Kitty Hawk indicates that there is continued public interest in protection of the area North of the proposed project (2.2miles) that is not currently included in the proposed plan. If a future project were constructed in this area, additional dredging in N1 and use of N2 would be required and time crowded perturbation would become a consideration.

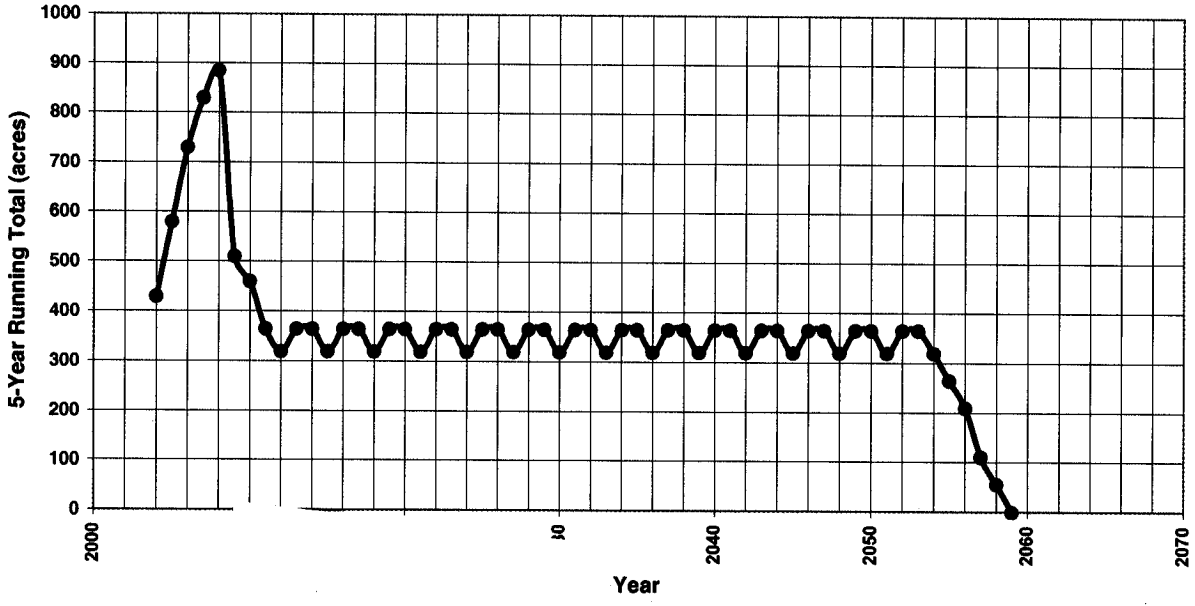
Direct dredging impacts in borrow area S1 include about 430 acres that would be excavated during the 3 year construction period. Excavation, performed in three phases, would average about 143 acres per year. Dredging for project maintenance would excavate about 70 acres of sandy bottom a year, beginning in year 4 and continuing throughout the 50 year project life. An average of about 76 acres of sandy bottom a year are expected to be affected by construction and maintenance dredging. Assuming a worst case 5 year recovery period, appropriate since dredging in adjacent areas may lengthen recovery time, the cumulative effects from time crowded perturbation at S1 would total about 345 acres of sandy bottom within S1 that could be undergoing benthic recovery at any given time.

Local Impacts:

a. Existing Sites: Cumulative impacts from space crowded perturbations would occur at a local scale, resulting from the use of both N1 and S1 for initial project construction. Based on a 5-Year running total , the largest area of affect would be at year 2008 when 885 acres are in recovery. After 2011 the area in recovery would range between 365 and 320 acres. See Chart 6-1, a 5-year recovery period assumes some impacts from time crowded perturbation at N1. This is considered a worst case assumption since recovery is expected more quickly than 5 years in the vicinity of N1, which is currently projected to be dredged only for initial construction. Average annual impacts of the proposed plan would be estimated at about 372 acres/year on a local scale.

b. Potential Sites: If the project were expanded to include the 2.2 miles requested by the Town of Kitty Hawk, this area could be expanded by 15% for a total of 428 acres/year on a local scale.

Chart 6-1 Five Year Running Total-Acres of Borrow Area Needed to Construct and Nourish The Dare County Beaches Project



Statewide Impac

a. Existing Site North Carolina ocean borrow site. It is located in the ne each (about 200 miles South). Dredging requirements ar years, about 20% of the 3 year maintenance requirement for the propo action. Assuming that the addition of this project would cause an incremental increase in impact area of about 20% (~ 74 acres/year),the cumulative impact area from space crowded perturbations statewide is estimated to be about 446 acres.

b. Potential Sites: The Wilmington District is in the early reconnaissance planning stage of the Dare County Beaches (Hatteras to Ocracoke portion) Study. While no details are available at this stage and any assumptions are highly speculative, consideration of potential beach nourishment that may come from this study was considered prudent for a worst case assessment. Public concerns have identified 6 "hot spots" of beach erosion where potential beach nourishment is proposed. It is assumed for this analysis that 10 miles of beach nourishment could occur as early

proposed for the Bodie Island portion of the study area with a resulting use of approximately 260 acres annually for borrow.

Project Vicinity Impacts

Similar Projects within a ~50 mile radius of the project area are described below.

USDOI MMS (1999) reports that, *Recently, the MMS has provided sand in Federal waters for several projects. Through a negotiated agreement with the U.S. Army Corps of Engineers (USACE) and the National Park Service (NPS) in July 1998, 134,000 cubic yards of sand were dredged from Great Gull Bank located 4 – 6 miles off Assateague Island and placed in low portions of the island to prevent breaching. The MMS and the City of Virginia Beach, VA signed a non-competitive lease agreement in April 1998 authorizing the use of 1.1 million cubic yards of sand from Sandbridge Shoal located in Federal waters to renourish the Sandbridge Beach.*

The annualized sand need for Sandbridge Beach is 300,000 cy (USDOI 1999). This volume is similar in scope to the Kure Beach project and incrementally the impact area for this analysis is assumed to be the same as that estimated for Kure Beach. These sites are remote to the Dare County project and time crowded perturbations to N1 and S1 would not occur.

The following tables graphically illustrate the relationship of the proposed borrow areas to the available habitat in the area. The available habitat area is estimated by multiplying the shoreline length of the area of consideration, by the distance from the shore of the offshore limit of proposed borrow areas. We recognize that other methods could be used to establish an area of available habitat, but believe this method to be both reasonable, and conservative, given the broad geographic range of the species discussed.

Local Cumulative Impact Area
(N1, N2 & S1)

Impact Area		Available Habitat			% Impacts	
Existing & Proposed	Potential	Shoreline length	Offshore Extent	Area Square miles	Existing & Proposed	Potential
372 acres (0.6 sq. mi.)	428 acres (0.7 sq. mi.)	20 miles	3 miles	38,400 ac. (60 sq mi)	1.0%	1.1%

Project Vicinity Cumulative Impact Area
(~50 mile radius) N1, N2 & S1
Sandbridge Va, Dare County (Hatteras to Ocracoke)

Impact Area		Available Habitat			% Impacts	
Existing & Proposed	Potential	Shoreline length	Offshore Extent	Area- Acres, Square miles	Existing & Proposed	Potential
446 acres (0.7 sq. mi)	706 acres (1.1 sq.mi)	100 miles	3 miles	192,000 ac, (300 sq.mi.)	0.2%	0.4%

Statewide Cumulative Impact Area
N1, N2 & S1
Kure Beach NC, Dare County (Hatteras to Ocracoke)

Impact Area		Available Habitat			% Impacts	
Existing & Proposed	Potential	Shoreline length	Offshore Extent	Area Square miles	Existing & Proposed	Potential
446 acres (0.7 sq. mi)	706 acres (1.1 sq.mi)	320 miles	3 miles	614,400 acres (960 sq mi)	.1%	0.1%

6.11.2 Summary of Dredging Impact on Significant Resources

Based on comments from resource agencies including National Marine Fisheries Service, Atlantic States Marine Fisheries Commission (ASMFC), Fish and Wildlife Service, NC Division of Marine Fisheries, NC Marine Fisheries Commission and others, the primary concern with the proposed use of the offshore borrow sites N1, N2 & S1 is the potential for adverse impacts on important commercial fish species. The concerns are typified by comments from the ASMFC.

We are particularly concerned with this proposed beach nourishment project because of the potential negative impacts on many of our managed species including striped bass, summer flounder, spiny dogfish, weakfish, and Atlantic Sturgeon. The proposed borrow site is important habitat for these species. According to survey work in the area, this site serves as striped bass wintering grounds, as well as spiny dogfish and summer flounder nursery areas. Tagging studies have indicated that fish

found in this area are from North Carolina as well as farther north along the coast to Maine ASMFC 2000.

The following FEIS sections describe potential impacts associated with this and other similar projects that are pertinent to this analysis.

6.01.2 Nearshore Ocean
6.04 Marine Resources
6.04.1 Dredging Impacts
6.04.2 Entrainment Impacts
6.04.3 Commercial and Recreational Fisheries
6.04.4 Essential Fish Habitat
6.04.5 Impacts on Cape Hatteras Sandy Shoal
6.04.6 Impacts to the Point
6.04.7 Impacts on Sargassum
6.04.8 Impacts on Reef-forming Corals
6.04.9 Impacts on Artificial Reefs
6.04.10 Impacts on Hardbottoms
6.04.11 Impacts on State Designated Areas Important for Managed Species
6.04.12 Impacts on the Marine Water Column
6.04.13 Impact Summary for Larval Entrainment
6.04.14 Impact Summary for Essential Fish Habitat
6.04.15 Impacts on Nearshore Ocean Invertebrates
6.07 Water Quality
6.12 Environmental Commitments and Mitigation

Concern for fish species has been raised regarding turbidity, noise, entrainment and other impacts related to operational activities. These impacts are fully discussed in the FEIS sections listed above, and were considered in preparation of this cumulative impact analysis. Of particular concern to the agencies is a cumulative degradation of habitat with an associated loss of benthic food resources. These are primary issues addressed in this analysis.

Resource Threshold Levels: We are aware of no established thresholds regarding the extent of ocean bottom that can be disturbed without significant population level impacts to fisheries. Therefore, a comparison of cumulative impacts to established thresholds is not made. It is clear from the above analysis however, that the potential impact area is small relative to the area of available similar habitat on a local, vicinity and statewide basis. It is expected that there is a low risk that the direct and cumulative impacts of the proposed action and other known similar activities would reach a threshold with potential for population level impacts on important commercial fish stocks. The following discussion provides support for this conclusion.

The DOI (1999) reports that *The pelagic/anadromous fisheries include those marine species that are free-swimming or highly migratory and therefore can avoid the areas of dredge activity. Direct impacts to this fishery could result from noise,*

entrainment, gill clogging, depletion of benthic food sources, and loss of relict shoal areas that may be utilized as navigation points for some migratory marine species (T. Goodger, NMFS, pers. comm., April, 1999). The importance of benthic communities in marine food webs leading to exploitable yields of pelagic and anadromous fish is widely recognized. Decimation of benthic community populations could result in a depletion of food source for the pelagic species (e.g., red drum, weakfish, silver hake) that rely on these organisms for sustenance (Newellet al. 1998a). Yet, the mobility of these fish species enables them to avoid the dredging operational areas and obtain food sources in other unaffected forage areas incurring insignificant adverse impacts to the fishery (T.Goodger, NMFS, pers. comm., April, 1999). There is also evidence that dredging operations may benefit fish species that feed within the water column by suspending food material (Courtenay et al. 1972). Bordering regions of dredge activity could provide suitable fishing grounds due to the resuspension of food particles. Spawning, egg dispersal, and juvenile development for these species occurs inshore and away from the study area resulting in minimal impacts to the stresses already imposed upon future stock abundance.

In regard to physical habitat alterations it is expected that alterations in depths and bottom sediment may occur and be persistent. However, site modifications would be within the range of tolerance by these species and, although man-altered, consistent with natural variations in depth and sediment within the geographic range of the Wintering Grounds and EFH for these species.

We acknowledge that some uncertainty regarding these potential impacts exists and therefore the proposed projects plan includes pre- and post- construction monitoring. The details of the monitoring plan will be developed in coordination with the concerned fisheries agencies.

6.11.3 Beach Impacts

Three major sources of beach impacts are considered in this cumulative assessment. These include local maintenance activities, disposal of dredged material from maintenance of navigation channels and beach nourishment.

Local Maintenance Activity: Under the existing condition the project area is subjected to repeated and frequent maintenance disturbance by individual homeowners and local communities following major storm events. These efforts are primarily made to protect adjacent shoreline property. Such repairs consist of dune rebuilding using sand from beach scraping. Limited fill and sandbags are generally used to the extent allowable by CAMA Permit. Such activities occur not only in the project area but also along all other developed North Carolina beaches. These frequent maintenance efforts could keep the natural resources of the barrier island ecosystems from reestablishing a natural equilibrium with the dynamic coastal forces of the area.

Beach Disposal: Throughout North Carolina, maintenance dredging of navigation channels places sand along the state's shoreline. The placement of such material occurs within the 320 miles of beachfront along the North Carolina coastline. Maintenance activities are listed in Attachment C and summarized below by mileage and maintenance schedule. The summary differentiates between beach disposal and nourishment. This breakdown is necessary to delineate between material placed in the swash zone versus on the upper beach and dune system. Calculations are based on estimated actual mileage used during any given disposal event. For instance, an approved 5-miles of ocean beach may be designated for disposal; however, during a given event only 0.4 to 1 mile of beachfront may be impacted. The assessment is made based on a 16-year period (2000-2015) and area impacts are discussed relative to the total length of North Carolina shoreline habitat available (320 miles).

Federal navigation projects have specific dimensions which are set by their authorizing documents and which remain constant until such time as their authorizations are modified through acts of Congress or specific authorities delegated to the Chief of Engineers. However, natural accumulation of sediment in the channels and harbors of these projects reduces their effective dimensions and impairs safe, predictable, and economic navigation. Therefore, maintenance dredging must be accomplished periodically in order to remove the shoals and restore the dimensions. Amounts of shoal material vary from year to year in response to the forces of nature, so dredging and disposal quantities and disposal lengths will vary likewise. Lengths reported are based on normal conditions.

Beach quality sand is a valuable resource that is highly sought by beach communities to provide wide beaches for recreation and tourism, as well as to provide hurricane and wave protection for public and private property in these communities. When beach quality sand is dredged from navigation projects, it has become common practice of the USACE to make this resource available to beach communities, to the maximum extent practicable. Placement of this sand on beaches merely represents return of material which eroded from these beaches, and is, therefore, replenishment with native material. The design of beach placement sites is very simple, generally starting at the high tide line and proceeding seaward, with a crest elevation not exceeding mean high water. Widths of beach placement zones generally reflect the wishes of the local government relative to the choice between a long, narrow beach or a shorter, wider beach.

Beach Nourishment: A description of beach nourishment activities is included in section 4.00 in the FEIS. This project is considered a typical beach nourishment project, although the length is greater than existing North Carolina projects. The impacts of the proposed project are Beach Disposal impacts discussed in section 6.00. The impacts of beach disposal on other North Carolina beaches are considered to be similar to those described herein. The degree of cumulative impact would increase proportionally with the total length of beach impacted.

As shown on Chart 6-2 below the North Carolina ocean beach (320 miles) can be divided based on the potential that a beach nourishment project will be proposed for them. The Coastal Area Management Act (CAMA) applies to all North Carolina Coastal Counties. Proper beach nourishment or disposal or local maintenance as described above is generally regulated under CAMA and Corps permitting authorities alone, and for this analysis, are labeled CAMA protected. Approximately 37% of North Carolina beaches are in this category. It could reasonably be expected that any developed and eroding beach in this category is likely experiencing local maintenance and may be considered for disposal or nourishment in the future. Other North Carolina ocean beach areas are unlikely to be considered for beach disposal. These are beaches within the Coastal Resources Barrier System (CBRS) (19%), or beaches that are owned and managed by either the State (4%)or Federal Government (40%), primarily as National or State Parks.

CRBA restricts the expenditure of Federal funds in designated areas. The large majority of existing or projected disposal and nourishment projects described below are Federal, with less than 2% of the activities conducted by private groups. While most CRBA lands are undeveloped, local maintenance activities would be expected in any developed portions. Federal and State parks allow highly restricted disposal under special use permit and conduct nourishment only as required to protect resources, such as at Assateague Island as described above. Only ~ 10% of all existing or projected disposal/nourishment in North Carolina are on beaches within this category. Of that number, 8% are potential nourishment projects in the early planning stage, which are highly speculative but included for worst case analysis.

This analysis quantifies these impacts in terms of the percent of North Carolina beach affected on an annual and total basis by sand disposal for maintenance of Federal navigation channels, and existing, proposed or potential beach nourishment projects. Activities of others are also considered.

Statewide Impacts. The following summaries are statewide impacts as calculated from information in Attachment D, which shows Wilmington District activities. In addition similar activities by others exist or are proposed and considered in this assessment. These activities include Figure 8 Island where private beach nourishment has occurred on about 2 miles of beach on 4 occasions between 1985 and 1999. The same area may be impacted by disposal as early as 2001 for inlet relocation. The Marine Corps currently proposes beach nourishment on about 1 mile of West Onslow Beach. Future nourishment of this site is possible.

Disposal Activities:

- Average/year – 8.0 miles or 2.5% of total NC ocean beach (320 miles)
- Minimum for any year – 3.5 miles or 1% of total NC ocean beach
- Total beach affected is 22.4 miles or 7.0% of total NC ocean beach

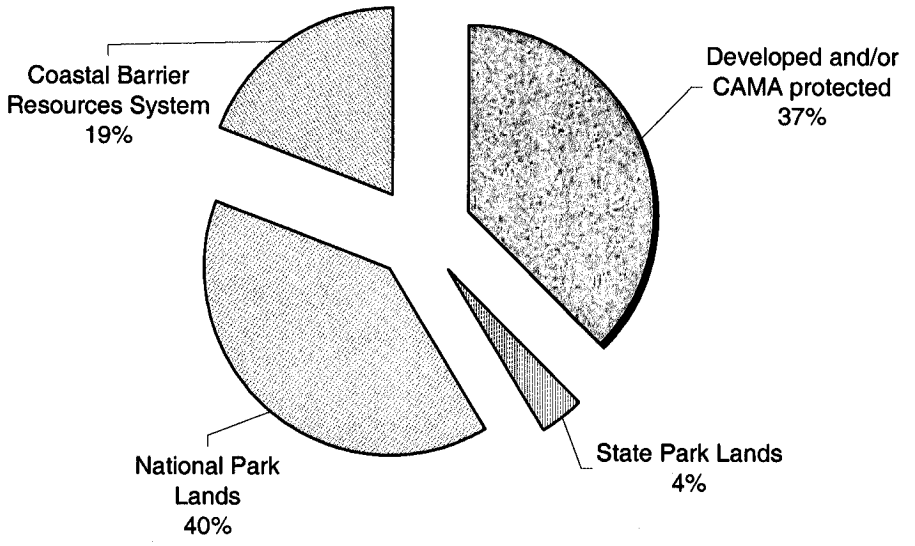
Existing Beach Nourishment:

- Average of 2.9 miles or 1% of NC ocean beach
- Minimum of 0 (possible that no beach nourishment in any given year)
- Total beach affected 9.8 which is 3% of NC ocean beach
- Inclusion of Figure 8 island (2 miles) - Total beach affected 11.8 miles or 3.7% of NC Beach

Proposed Beach Nourishment
(These numbers are highly speculative and subject to change. Includes best guess for projects that are in early study phases, i.e. study requested but not funded, & reconnaissance).

- Average of 16.9 miles or 5.3% of NC ocean beach
- Minimum would be 0 (possible none would occur in a given year)
- Maximum of 85.0 miles which is 26.6% of NC ocean beach
- Inclusion of Onslow Beach (1 miles) and Kitty Hawk North (2.2 miles) - Total beach affected 88.2 miles or 27.5 % of NC ocean beach

Chart 6-2. North Carolina- CAMA, Park Land, or CRBA Protected Beaches

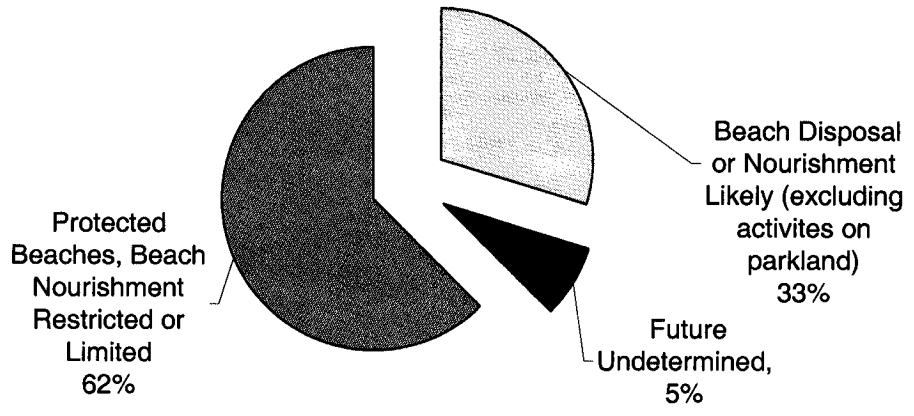


Cumulative
(Disposal and nourishment projects existing and future.)

- Average annual impact from existing disposal and nourishment 11.0 miles, 3.4 % of NC beaches.
- Maximum impact (worst case) from existing beach disposal and nourishment activities 32.2 miles, 10.1% of NC ocean beach.
- Average impact from existing disposal and nourishment projects and proposed projects 27.8 miles, 8.7% of NC ocean beach.
- Maximum impact (worst case) from Wilmington District existing disposal and nourishment and potential beach nourishment 119.4 miles, 37.3% of NC ocean beach.
- Inclusion of Onslow Beach (1 miles), and Figure 8 (2 miles) - Total beach affected 122.4 miles or 38 % of NC ocean beach

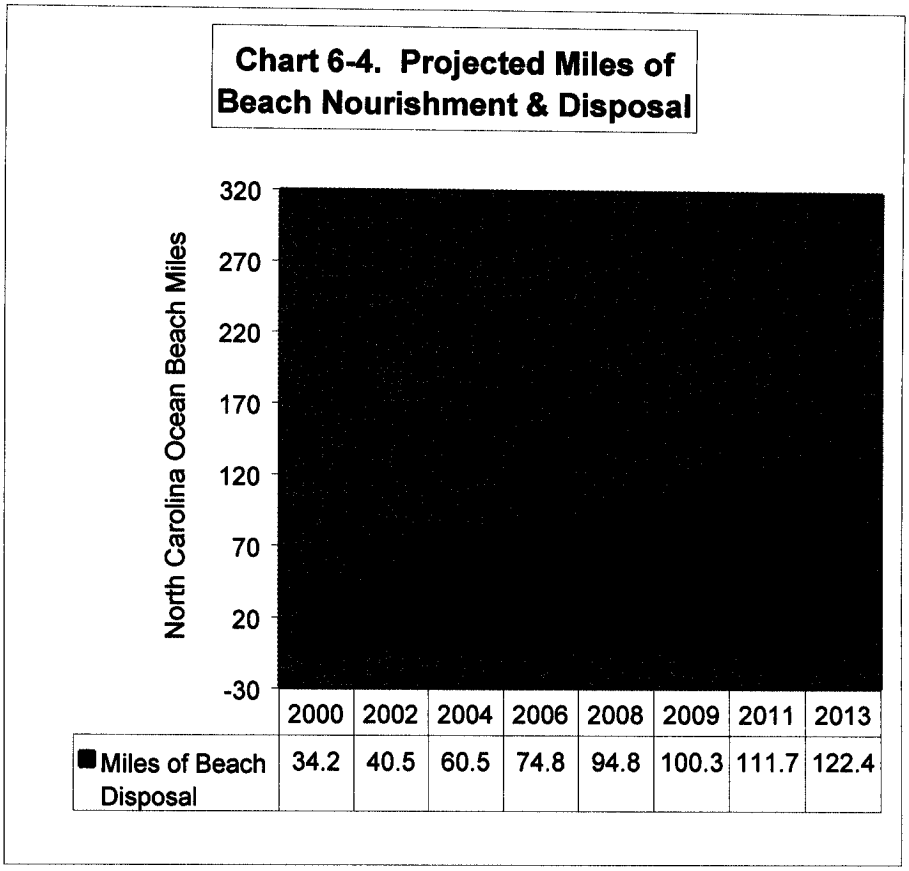
Chart 6-3 shows how existing and proposed activities may be distributed statewide.

Chart 6-3. North Carolina Beaches- Potential for Nourishment or Disposal



It is interesting to note that ~5% of the North Carolina ocean beach is not regulated beyond CAMA and the Corps, and is not proposed for beach nourishment or disposal. The future of this area is undetermined. Due to extreme development pressure, however, these are likely to be developed in the future unless additional protection is provided at a state or Federal level.

As shown on Chart 6-4, Beach disposal/nourishment activities are relatively limited under the base condition, 34 miles (~10%). These activities could potentially increase to 122 miles as early as 2013; over a 3 fold increase in the next 13 years. Incrementally, the proposed project would account for ~6% of the increase.



Project Level Impacts
(20 mile study area)

a. Local Maintenance:

- Under existing conditions 20 miles are expected to experience frequent local maintenance, in the form of beach scraping and bulldozing, etc.
- With the Federal project, 14.2 miles (70%) would be under a 3 year maintenance cycle with local maintenance highly restricted. Approximately 5.7 miles would remain under local maintenance.

b. Disposal Activities: None

c. Existing Beach Nourishment: None

d. Proposed Beach Nourishment:

- 14.2 miles or 71% of study area proposed for nourishment
- potential 2.2 mile extension, for a total of 82% of study area

e. Cumulative Impacts:

- 14.2 miles or 71% of study area proposed for nourishment
- potential 2.2 mile extension, for a total of 82% of study area
- remainder 2.8 miles 14% subject to continued local maintenance.

Vicinity Impacts
(50 Miles North and South of the project (100) miles)

a. Local Maintenance:

- Under existing conditions ~38 miles 38% are expected to experience frequent local maintenance.
- With project 14.2 miles (14%) would be under Federal maintenance 3 year cycle with local maintenance highly restricted. 23.8 would continue under local maintenance.

b. Disposal Activities: 2.3 miles or .02% of the ocean beach in the project vicinity

c. Existing Beach Nourishment: None

d. Proposed Beach Renourishment:

- 14.2 miles, or 14% of study area proposed for renourishment
- potential 2.2 mile extension for a total of 16% of study area
- additional potential nourishment of 10 miles of hot spots 26% of the beach impacted

e. Cumulative Impacts:

- existing condition includes 2.3 miles of beach disposal
- With all proposed and existing disposal and nourishment impacts, 28.7 miles or 29% of the beaches in the vicinity would be impacted.

6.11.4 Summary of Beach Disposal Impact on Significant Resources

Based on comments from resource agencies and others, the primary concern with the proposed beach disposal is the potential for adverse impacts on important commercial fish species due to disposal impacts on larvae and indirect impacts to fish and birds due to impacts on beach invertebrates. The concerns are typified by comments from the NCDMF.

The Division is concerned with the adverse impacts that will occur from the project. Biological resources will be affected by dredging of material for initial project construction and by placement of material on the beach. These impacts will reoccur as the area is renourished. As stated in the document the surf zone and the nearshore waters are utilized by kingfishes, spot, croaker, bluefish, weakfish, spotted sea trout, summer flounder, striped bass, spiny dogfish, Atlantic sturgeon and other commercially and recreationally important species.

The following FEIS sections describe potential impacts associated with this and other similar projects that are pertinent to this analysis.

6.01.1 Beach and Dune
6.04.16 Impacts on Beach Invertebrates
6.09.6 Piping Plover

Concern for fishery resources have been raised regarding turbidity impacts. These impacts are fully discussed in the FEIS sections listed above, and were considered in preparation of this cumulative impact analysis. Of particular concern to the agencies is a cumulative degradation of habitat with an associated loss of benthic food resources for fish and birds. These are primary issues addressed in this analysis.

Resource Threshold Levels: We are aware of no established thresholds regarding the extent of ocean beach that can be disturbed by beach disposal/nourishment without significant population level impacts on birds and fisheries that rely on the beach invertebrates for food. Therefore, a comparison of cumulative impacts to established thresholds is not made. A relatively small portion of North Carolina beaches is presently affected by these activities, about 11%. With the proposed action the impact area would increase to 15%. The existing and proposed sites are distributed in northern and southern parts of the state with existing nourishment sites in New Hanover County and the proposed action in Dare County. It is unlikely that cumulative impacts from space crowded perturbation are occurring or will occur with the construction of this project. The analysis suggests that the potential impact area from the proposed and existing actions is small relative to the area of available similar habitat on a vicinity and statewide basis. These areas are expected to recover food resources, which should continue to be available. It is expected that the risk that the direct and cumulative impacts of the proposed action and other existing similar activities, would reach a threshold with high potential for population level impacts on important commercial fish stocks and birds is low. The following discussion provides support for this conclusion.

(DOI 1999) reports that *As with benthic organisms living in borrow areas, benthic organisms are significantly impacted by beach nourishment activities (Nelson 1985; Van Dolah et al. 1992). These impacts, however, are considerably shorter in duration than the impacts observed in offshore borrow areas. Because benthic organisms living in beach habitats are adapted to living in high energy environments, they are able to quickly recover to original levels following beach nourishment events; sometimes in as little as three months (Van Dolah et al. 1994; Levison and Van Dolah 1996). This is again attributed to the fact that intertidal organisms are living in high energy habitats where disturbances are more common. Because of a lower diversity of species compared to other intertidal and shallow subtidal habitats (Hackney et al. 1996), the vast majority of beach habitats are recolonized by the same species that existed before nourishment (Van Dolah et al. 1992; Nelson 1985; Levison and Van Dolah 1996; Hackney et al. 1996). Rakocinski et al.I*

We acknowledge that some uncertainty regarding the rate of repopulation of food organisms and the potential for reduced population levels due to continual sand deposition exists. The proposed project plan therefore includes pre- and post-construction monitoring of beach fauna. The details of the monitoring plan will be developed in coordination with the concerned fisheries agencies.

6.12 Environmental Commitments and Mitigation

6.12.1 Commitments

The environmental goal of this project is to avoid and minimize adverse impacts to the extent practicable. These Commitments have been divided into two categories Offshore Dredging and Beach Disposal.

OFFSHORE DREDGING:

These activities will be conducted before, during, and/or after construction.

1. No expansion of borrow area will be made without prior survey and clearance for hardbottoms and cultural resources.

2. Agency concerns regarding use of offshore borrow sites within an area that is wintering grounds and Essential Fish Habitat (EFH) for important commercial and sport species indicate that some additional monitoring is justified. The Corps will address these issues through the development of an integrated monitoring plan as described in 6.12.2. The Corps will provide coordinates for excavated portions of all borrow areas to the USFWS so the areas can be considered for sampling as a part of the Southeast Area Monitoring and Assessment Program (SEAMAP) Cooperative Winter Tagging Cruises by the USFWS.

3. The current status of identified potential hardbottoms EFH habitat area of particular concern, located in the vicinity of proposed borrow site, S1 will be assessed by sidescan sonar or other appropriate means by the Corps prior to initial construction (PED). If present, sites will be identified on construction drawings so that they can be avoided and protected from physical impacts due to anchoring of equipment

BEACH DISPOSAL:

These activities will be conducted before, during, and/or after construction.

4. Due to resource agency concern regarding uncertainties of the potential impacts of disposal of sand on the beach during the summer months (for construction only) and long term impacts of repeated beach disposal year-round, some additional monitoring is justified. The Corps will address these issues through the development of an integrated monitoring plan as described in section 6.12.2.

5. Periodic nourishment (maintenance) will occur between Nov 16 and April 30 to the degree practical. As agreed in previous protocol developed with USFWS, the following actions will be taken:

- A sea turtle nest-monitoring program will be implemented by the Corps during initial construction or periodic nourishment if dredging and disposal occur during sea turtle nesting season as described in Section 6.09 Endangered Species.

- After placement of dredged material during construction and each nourishment event and prior to the first turtle-nesting season, the beaches will be monitored for compaction by the Corps. If the beach hardness exceeds 500 cone penetrometer units, the beach will be tilled. The beach will be monitored for escarpment formation prior to each nesting season by the local sponsor. If an escarpment exceeds 18 inches, then it will be leveled by the local sponsor.

- From May 1 through November 15, construction pipes that are placed parallel to the shoreline will be placed as far landward as possible when passing over completed sections of the project. Temporary storage of pipes and equipment shall be off of the beach.

6. During construction from May 1 through November 15, all lighting on the beach associated with project construction shall be minimized to the maximum extent practicable while maintaining compliance with all safety requirements. Reduced wattage and special fixtures or screens to reduce illumination of adjacent beach and near shore waters shall be used if practical.

7. Should a hydraulic pipeline dredge be used, the pipeline from the borrow area to the disposal beach will be submerged until it reaches nearshore waters. The pipeline would be marked to let commercial and recreational boaters know of its presence along the bottom. Work barges and other appurtenances associated with a pipeline dredge operating in open water would be moored so as to minimize interference with boat traffic in the area.

8. Surveys of the project area for *amaranthus* will be conducted prior to any disposal operation (initial construction and periodic nourishment) by the Corps. If *amaranthus* were found within the construction or maintenance impact area, Section 7 coordination with USFWS would be reinitiated.

9. As built plans will be provided to NOAA upon project completion.

10. Beach profile surveys will be performed yearly during the spring and will cover the area from the Kitty Hawk Pier southward to a point 2 miles south of the southern terminus of the south portion of the project. The surveys will include both onshore profiles and offshore profiles. The onshore profiles will be taken at 500-foot intervals and will cover the area from the back toe of the dune seaward to wading depth (approximately 0 to –2 feet NGVD). The offshore profiles will be taken every

1,000 feet and will extend seaward to a depth of at least –27 feet NGVD. Vertical aerial photography will be taken each spring and will cover the area from Southern Shores south to the north end of Pea Island.

6.12.2 Mitigation

Project impacts will be minimized by avoidance of significant resources such as hard bottoms and significant cultural resources. Commitments listed in section 6.12.2 will further reduce or minimize potential project impacts to important resources.

The project area provides high quality habitat (wintering and spawning ground) for commercially important fishes. Agencies are concerned regarding the long term effects of beach disposal (including the placement of construction material during the summer months) and ocean dredging on commercially important fish species, due to turbidity, habitat alteration and reduced benthic food. Beach invertebrates also provide food for shore birds. The high quality of the sediment selected for excavation and beach fill, the small length of beach affected at any point in time, the wide distribution of these species in relation to the area of habitat affected, and expected rapid recovery of the benthic resources would not suggest that the proposed project, poses a significant threat. However, due to the importance of the marine and other resources on the area, we believe that monitoring is appropriate to demonstrate reasonable indication of expected recovery of benthic food sources in the borrow area and to identify any unforeseen significant impacts to larval, juvenile and adult fish, and shorebirds in the borrow and beach placement area.

The Corps will address these issues through the development of an integrated pre- and post-construction monitoring plan. This plan will be developed during 2001 through coordination with known interested agencies or institutions, and monitoring should be implemented in 2002. This will be two years prior to project construction scheduled for 2004. The plan will consider results from ongoing monitoring studies as described below to identify reasonable and prudent investigations that will establish baseline conditions, and assess construction, short term, and long term impacts on habitat and/or indicator species.

Except for an offshore borrow area not being involved, a similar integrated monitoring plan for beach disposal actions on several beaches in Brunswick County, North Carolina is currently being coordinated and should be implemented in early 2001. Information gathered from this coordination and monitoring effort will be helpful in the development of the monitoring plan for this project. It is expected that pertinent data from the Brunswick County study will be available prior to construction of the proposed project, which is not scheduled to begin until 2004.

No compensatory mitigation is proposed for this project.

7.00 ENVIRONMENTAL COMPLIANCE

7.01 Air Quality

Temporary increases in exhaust emissions from construction equipment are expected during the construction and maintenance period. The project is in compliance with Section 176 (c) of the Clean Air Act, as amended (CAA). The air quality in Dare County, North Carolina, is designated as an attainment area. The State of North Carolina does have a State Implementation Plan ("SIP") approved or promulgated under Section 110 of the CAA. However, for the following reasons, a conformity determination is not required:

a. 40 CFR 93.153 (b), "For Federal actions not covered by paragraph (a) of this section, a conformity determination is required for each pollutant where the total of direct and indirect emissions in a nonattainment or maintenance area caused by a Federal action would equal or exceed any of the rates in paragraphs (b) (1) or (2) of this section." Dare County has been designated by the State of North Carolina as an attainment area.

b. The direct and indirect emissions from the project fall below the prescribed deminimus levels (58 Fed. Reg. 93.153(c)(1)) and, therefore, no conformity determination would be required.

c. The project is located within the jurisdiction for air quality of the Washington Regional Office of the NCDENR. The ambient air quality for Dare County has been determined to be in compliance with the National Ambient Air Quality Standards. This project is not anticipated to create any adverse effect on the air quality of this attainment area.

7.02 Coastal Zone Consistency Determination

The project will take place in the designated coastal zone of the State of North Carolina. Pursuant to the Federal Coastal Zone Management Act (CZMA) of 1972, as amended (P.L. 92-583), federal activities are required to be consistent to the maximum extent practicable with the federally approved coastal management program of the state in which their activities would be occurring.

a. Areas of Environmental Concern (AEC): The NED plan alternative would take place in areas under the North Carolina Coastal Management Program designated as AEC. Specifically, the activities will occur in the Public Trust Areas and the Ocean Hazard System and will affect the following AEC: Public Trust Areas, Ocean Erodible Area, High Hazard Flood Areas. The following determination has been made regarding the consistency of the proposed project with the State's management objective for each of the AEC affected:

(1) Public Trust Areas: The NED alternative is an acceptable use within public trust areas. The plan will not be detrimental to the biological and physical functions of public trust waters.

(2) Ocean Erodible Areas: The discharge of material on the beach would not cause any significant adverse effect to ocean erodible areas.

(3) High Hazard Flood Areas: Discharge of material on the beach would provide temporary protection for high hazard flood areas.

b. Other State Policies: The proposed project has been determined to be consistent with other state policies found in the State's Coastal Management Program document that are applicable. These include:

(1) North Carolina Mining Act: The removal of dredged material from the offshore borrow area has been reviewed by the North Carolina Division of Land Resources and a determination has been made that removal of sand from the sea floor within the three miles territorial limits is not an activity that would be classified as mining under the North Carolina Mining Act (15A North Carolina Administrative Code Subchapter 05A .0200).

(2) Shoreline Erosion Policies: The construction of a dune berm system as a means of controlling erosion along the ocean front is consistent with state regulations for development in Ocean Hazards Areas of Environmental Concerns (AECS'), and under 15 North Carolina Administrative Code 7M - Section .0200 - Shoreline Erosion Policies.

c. Local Land Use Plan: This project is consistent with local Land Use Plans for Kitty Hawk, Kill Devil Hills and Nags Head.

Based on the information presented within this FEIS, the proposed project is consistent with the North Carolina Coastal Management Program. This determination has been provided to the State for its review and concurrence.

7.03 EO 11990, Protection of Wetlands and EO 11988, Flood Plain Management

The NED plan alternative will not impact wetlands pursuant to EO 11990. Project construction will occur in flood plain areas. However, no practical alternative exists to locating the proposed project in the flood plain. Every effort will be taken to minimize potential harm to or within the flood plain. The action is in compliance with State/local flood plain protection standards.

7.04 Prime and Unique Agriculture Land

According to the Soil Survey of Dare County, North Carolina, the soils on the beach that may be impacted by the proposed project are not designated by the Natural Resource Conservation Service (NRCS) as prime or unique agriculture lands. No impacts to prime and unique agriculture lands will occur.

7.05 Wetland Construction

All materials dredged will be used as beachfill for construction and maintenance of the recommended plan alternative. No excess material will be available for construction of wetlands under the provisions of Section 150 of the Water Resources Development Act of 1976 (P.L. 94-587).

7.06 Marine, Protection, Research, and Sanctuaries Act

The proposed beach nourishment project does not involve ocean disposal of dredged material. Therefore, the project is considered to be in compliance with the requirements of the Act.

7.07 Coastal Barrier Resources Act

The Coastal Barrier Resources Act (CBRA) of 1982 (P.L. 97-348) prohibits expenditure of Federal funds for activities within the designated limits of the Coastal Barrier Resources System unless specifically exempted by Section 6 of the Act. As stated in that section, Federal expenditures are allowable in association with maintenance of existing channel improvements, including disposal of dredged material related to such improvements. Designated maps showing all sites included in the system in North Carolina show Nags Head Woods (NC-02) to be within the Coastal Barrier Resource System and protected under the Coastal Barrier Improvement Act of 1990 (USFWS 1990). This site is within the study area (Figure 7-1) but does not include beachfront and would not be affected by the recommended plan. Therefore, the proposed action is in compliance with CBRA.

7.08 Hazardous and Toxic Waste (HTW)

The U.S. Army Corps of Engineers standard tiered approach for analyzing the potential for encountering contaminated sediments in the potential borrow areas was used to assess the potential borrow areas for HTW. According to this analysis, before any chemical or physical testing of sediments is conducted, a reason to believe that the sediments may be contaminated must be established. The sources of the sediments in the selected borrow areas are derived from sediment transport and deposition by ocean currents. The probability of the sites being contaminated by pollutants is low since no use of the beach front (potential nourishment area), or the nearshore ocean potential borrow areas, as an industrial site, dump, or disposal area for other than dredged material, was identified during the study.

An ocean outfall for a desalinization plant is located between the north and south borrow areas. This outfall should not be affected by dredging or disposal operations. The bottom sediments that will be dredged from the borrow areas and placed on the beach will consist of predominately fine-to-medium grain size with some shell. Therefore, no further analyses or physical and chemical testing of the sediments is recommended. It is not expected that any hazardous and toxic waste sites would be encountered during construction or maintenance. However, if any hazardous and toxic waste sites are identified, response plans and remedial actions will be the responsibility of the local sponsor.

7.09 Relationship Between Short-Term Impacts and Long-Term Benefits and Irreversible and Irretrievable Commitments of Resources

Impacts associated with construction and maintenance activities are discussed in Section 6.00. There would be irreversible and irretrievable commitments of fuel and manpower resources to construct and maintain the selected alternative. Any impacts associated with this project are considered acceptable considering the overall public benefits of the project.

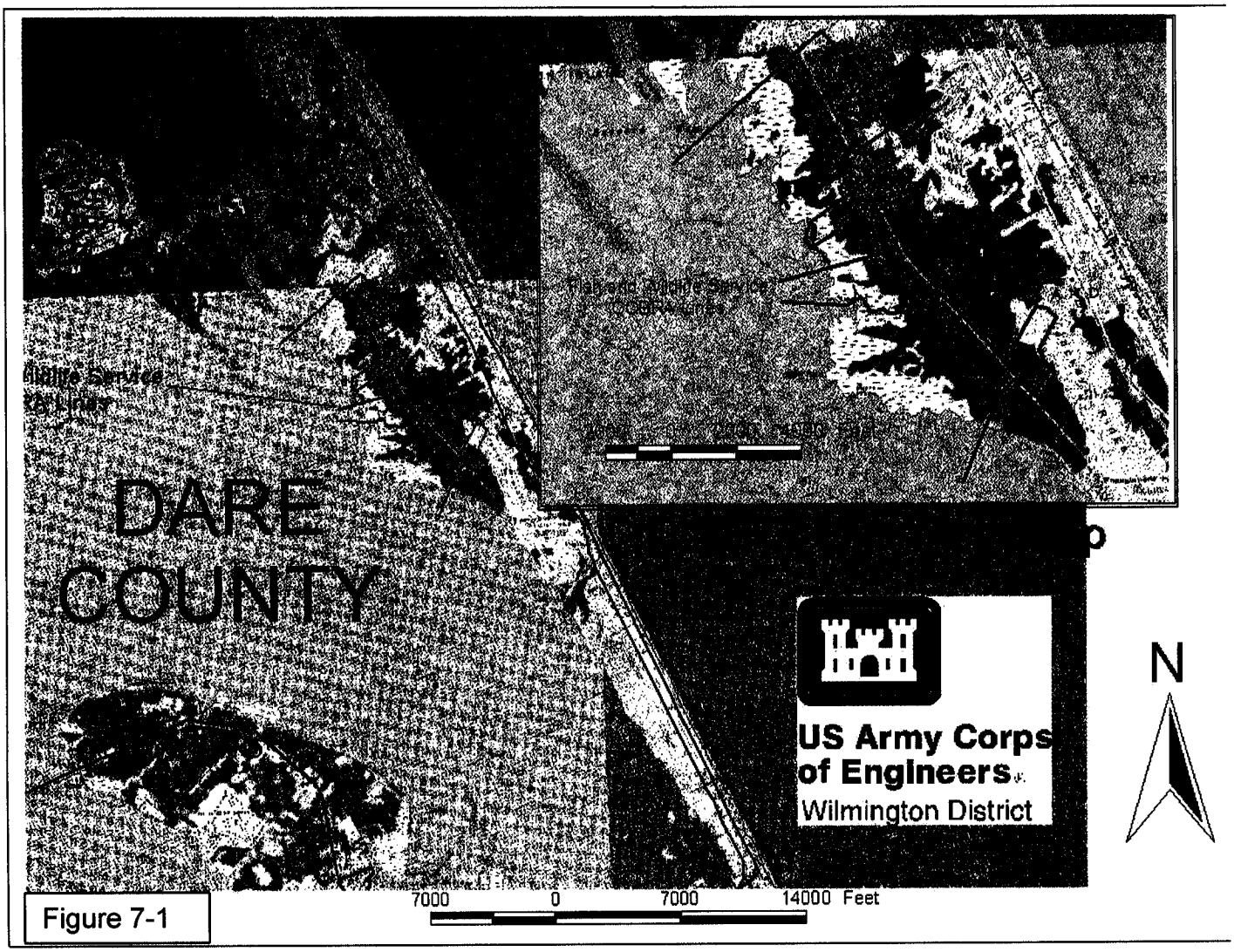

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Figure 7-1

8.00 PUBLIC AND AGENCY COORDINATION

8.01 Scoping

A scoping letter describing the proposed Dare County Beaches Study and requesting public and agency participation was circulated in June 1997. Agency and public responses were received from; U.S. Department of Interior, USFWS, U.S. Department of Commerce, NMFS, State of North Carolina (Division of Water Quality, Division of Environmental Management, Division of Coastal Management, Department of Transportation and North Carolina Wildlife Resources Commission) and five private individuals. A Draft Fish and Wildlife Coordination Act Report was provided by the USFWS in July 1999. Comments received addressed various aspects of the project. These comments generally requested a comprehensive analysis of potential alternatives (including local solutions) and identified resource concerns needing to be addressed. These comments were considered during project planning and EIS preparation.

8.02 Fish & Wildlife Service Coordination

The Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661, et seq), requires that the Corps of Engineers coordinate and obtain comments from the USFWS. A Draft Fish and Wildlife Coordination Act Report (Feasibility Report, Appendix B) was provided by the USFWS in July 1999 under the Fish and Wildlife Coordination Act. Specific recommendations and USACE responses are presented in the following paragraphs.

1. USFWS COMMENT: The EIS should define the level of storm for which protection is sought; the type(s) of storm damage that would be reduced; and, those locations within the project area for which protection is sought.

CORPS RESPONSE: Beach nourishment projects are no longer formulated according to meeting a desired level of protection. Rather, the project dimensions are optimized based on the project size yielding the largest net benefits. Using a 50-year life cycle approach, the beaches are subjected to a randomly generated group of storms. The project dimension yielding the biggest spread between benefits and costs is the NED Plan.

The types of storm damages reduced include flooding, wave, and both storm-related and long-term erosion. Dare County constituents throughout the study area have expressed desire for storm damage protection; however, only the recommended project limits have been found to be economically feasible.

The plan formulation process involves the assessment of the degree of storm damage reduction provided by a wide range of beach fill configurations. The level of storm damage reduction for a particular fill configuration is determined by simulating hundreds of 50-year life cycles using risk and uncertainty principles. Through a random selection process, a particular 50-year

simulation may include numerous low frequency events (i.e. severe storms) or perhaps none. Once all of the 50-year life cycle simulations are run for a particular plan, the average storm damage reduction potential afforded by a particular design configuration is computed. The storm damage reduction potential for a particular plan is computed in terms of the "net benefits" afforded by the plan. Net benefit is defined as the difference in the average annual benefits associated with a particular fill configuration and the average annual cost for that configuration. Once a full range of project configurations or plans have been analyzed, the plan that results in the maximization of the "net benefits' becomes the National Economic Development (NED) Plan. Identification of the NED plan establishes the maximum level of Federal participation in the plan in terms of total Federal cost and percent cost sharing. The local sponsor of the project may choose a smaller, less costly plan or a plan larger more expensive plan. Selection of a plan other than the NED plan is referred to as a locally preferred plan. In the case of the smaller plan, the Federal Government can cost share at the same percentage as the NED plan providing that the smaller plan is economically feasible, i.e., the benefits exceed the costs. For the larger plan, the Federal Government would only pay an amount equal to its share for the NED plan. Any cost over the NED plan would be the responsibility of the non-Federal sponsor.

2. USFWS COMMENT: EIS should present the entire range of alternatives that achieve the desired storm damage reduction without regard for cost, social impacts, or the jurisdictional authority of the Corps. Two excellent references (Bush et al. 1996 and Pilkey et al. 1998) should be consulted.

CORPS RESPONSE: The EIS includes a discussion of structural, nonstructural and no action alternatives. Also see response to comment #4.

3. USFWS COMMENT: Would a series of smaller sediment placements, perhaps on an annual basis, be more cost efficient in achieving the desired level of storm damage reduction?

CORPS RESPONSE: No. Economies of scale when moving sand are significant. By dredging more often to place a series of smaller volumes, one would encounter far more mobilization costs.

Maximization of the net benefits is based on providing the design configuration for a particular area essentially all of the time. Thus, smaller cross-sections would not be an option with respect to providing the same degree of storm damage reduction or net benefits along a particular segment of the project as called for by the NED plan or locally preferred plan. Constructing and maintaining shorter segments is an option that we will include in our project implementation planning. The length and number of segments will be controlled by economics, the physical performance aspects of the plan, the financial capability of the non-Federal sponsor, and the

environmental consequences associated with frequent to less frequent nourishment operations.

4. USFWS COMMENT: Would the proposed artificial beach-dune system provide protection against such low intensity storms (e.g., hurricane categories 1 and 2) and to such a limited area of structures that a program of selective relocation, strict zoning/setback requirement, retrofitting existing buildings, and stricter building codes for new buildings be more cost efficient?

CORPS RESPONSE: "Nonstructural" measures were considered as required by Federal planning regulations. These measures usually include relocation, elevating, or waterproofing of buildings to reduce susceptibility to damage. The only nonstructural measure that would substantially reduce damages in the project areas is structure relocation. While relocation would reduce damage to structures, it would not prevent loss of property, associated tax values, emergency costs or loss of recreational values. Given the high costs of structures, loss of benefits, and the impracticality of moving thousands of structures, relocation is an economically infeasible alternative. An evaluation of the non-structural alternative is included in Appendix H.

5. USFWS COMMENT: The Corps should establish a program to monitor dredging impacts on primary productivity and benthic invertebrate community composition. The program should assess the biomass and species compositions of organisms that recolonize borrow areas. The program should include pre-project baseline data and post-project data at one-, three-, five-, and ten-years after dredging. The program should use at least one area each among the two northern and three southern borrow area groups. At three, five, and ten years after sediment removal, data collected should be compared with offshore fisheries data (e.g., species composition, diversity, food habits, landings, catch per unit effort, and other appropriate information) in order to produce an overall evaluation of dredging impacts on offshore fisheries. If these comprehensive evaluations indicate that fisheries resources have been adversely affected, the Corps should work with the Service and National Marine Fisheries Service to develop a mitigation program for the remaining decades of the project.

CORPS RESPONSE: Agency concerns regarding use of offshore borrow sites within an area that is wintering grounds and Essential Fish Habitat (EFH) for important commercial and sport species indicate that, some additional monitoring is justified. The Corps will address these issues through the development of an integrated monitoring plan as described in 6.12.2. The Corps will provide coordinates for excavated portions of all borrow areas to the USFWS so the areas can be considered for sampling as a part of the Southeast Area Monitoring and Assessment Program (SEAMAP) Cooperative Winter Tagging Cruises by the USFWS.

6. USFWS COMMENT: The Corps should ensure that no hardbottom

habitats are affected by sedimentation produced by the project; either as a result of offshore dredging or sediment washing off the beach. This goal may be accomplished by actual surveys of the borrow sites and the review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP). The Corps should fund a program to measure sedimentation and biological productivity in selected hardbottoms in all areas surrounding the borrow areas. If hardbottoms are adversely affected, the project should include specific measures to mitigate any adverse impacts.

CORPS RESPONSE: Sidescan sonar surveys of potential borrow areas did not identify hardbottom within any of the proposed borrow sites. Collection of sediment core samples within borrow areas confirm absence of hardbottom within the borrow sites. No expansion of borrow sites would be made without additional survey to confirm the absence of hardbottom.

Review of data provided by the Southeast Monitoring and Assessment Program (SEAMAP) identified one area of hardbottom and one area of potential hardbottom in the project vicinity. The hardbottom site identified by SEAMAP is located over a mile away from the nearest point of proposed borrow site S1 and several miles from N1, and N2. These sites are located about one mile off the beach beyond the closure depth for the project. The borrow materials are predominantly sand and any sedimentation due to dredging would be localized to the immediate dredging area and would not be expected to impact adjacent areas. It is expected that the identified hardbottom and the potential hardbottom, if present, are ephemeral since SEAMAP transects include both positive and negative evidence of hardbottom in subsequent surveys.

The current status of the aforementioned hardbottom areas will be assessed by sidescan sonar prior to construction and maintenance and if present will be identified on construction drawings so that they can be avoided and protected from physical impacts due to anchoring of equipment.

7. USFWS COMMENT: In order to minimize both the direct and indirect impacts of turbidity and subsequent sedimentation, the Corps should ensure: (1) that the project not use sediment which consists of more than ten percent silt and clay particles; and, (2) the project should use only the three coarsest grades of sand (medium, coarse, and very coarse). These construction restrictions would not only reduce turbidity, but would also prolong the life of the artificial beach-dune system and thereby increase the time between beach-dune reconstruction. The project EIS should contain a Sand Suitability Analysis in accordance with procedures of the Corps' Coastal Engineering Research Center.

CORPS RESPONSE: The material lying within the potential borrow areas meets the 10 percent fines criteria. A comprehensive compatibility analysis

has been performed for all of the potential borrow areas in accordance with standard coastal engineering practice. The material in the potential borrow areas has been found to be compatible with the existing native beach sand with overfill factors ranging from 1.1 to 1.2. The overfill factors include winnowing losses for the fine-grained sediments.

8. USFWS COMMENT: Since there is no single period of the year when work could be scheduled to avoid adverse impacts to all the fish and wildlife resources in the project area, the best way to minimize adverse impacts is to reduce the duration of construction. Reduced construction time can be achieved by the simultaneous use of more than one dredge. On balance, the most limited resources, e.g., an undisturbed beach, would benefit from dredging during the winter months. Therefore, the USFWS recommends that initial construction be accomplished by using at least two dredging vessels that commence work on or after October 1. These vessels would work as weather allows through the winter and attempt to finish initial construction by March 31. If some work remained after March 31, these vessels would continue work into the spring until work was completed. Sediment replacement operations should follow a similar pattern, but with a reduced work period. Replacement operations should be limited to the period from November 1 through the end of February. Scheduling beach disposal outside the larval recruitment period of beach invertebrates will ensure better recovery of these species.

CORPS RESPONSE: Because of the large scale of this project, the low production rates anticipated during the winter months, and uncertainty regarding the availability of multiple dredges, it is not practical to construct this project during the window suggested.

There is a limited amount of dredge plant that is capable of constructing this project and some of this dredge plant will be required for construction and maintenance of other navigation and beach projects. Therefore, there is no guarantee that the industry will be able to furnish two dredges for this project at a price that will be economically feasible. The Corps generally does not dictate equipment requirements in its contracts. The contractor will determine how he will accomplish the work and what pieces of equipment will be needed to satisfy contract requirements. However, it is expected that at least two dredge plants working concurrently will be required for a portion of the project to complete construction within a proposed 3-year construction period.

With two dredges starting work October 1, construction would require about 19 months to complete, extending well beyond March 31 of that year. We have proposed a schedule that divides the project into four segments and assumes that at least two segments will be constructed concurrently. Disposal operations will begin as soon as practical after the previous sea turtle nesting season (November 15) and continue until construction of a

given segment is complete (about 8-12 months). Any subsequent segment would also begin after November 15 to avoid the need for preconstruction sea turtle nest monitoring and reducing potential nesting impacts.

Initial construction will be followed by periodic nourishment (approximately every three years). It is proposed that this work would begin after 15 November and be completed prior to 1 May to the degree practical.

9. USFWS COMMENT: If sediment placement extends into the sea turtle nesting and hatching season, May 1 through November 15 of any year, the Corps must initiate formal consultation in accordance with Section 7 of the Endangered Species Act. Sediment placement during this period will require a program of sea turtle nest monitoring and relocation. Furthermore, the Corps should incorporate measures designed to help state-approved sea turtle monitoring programs into formal project plans.

CORPS RESPONSE: Due to the large scale of this project, avoiding the sea turtle nesting season during construction would increase the project cost by about $14.5 million, (about 21%), for additional mobilizations and increased dredging costs. This would also extend the construction period from 3 years to 6 years. We believe this is impractical and propose a construction schedule that would use up to 3 mobilizations beginning after the previous nesting season is over (November 15) and continue until complete. This schedule will require work during the sea turtle nesting season that begins on May 1.

The proposed beach disposal area is at the Northern extent of the sea turtle nesting range, historic numbers are low (from 0-6 nest per year) for the project area. A sea turtle nest monitoring and relocation program is proposed during construction to offset any impacts. The sea turtle nesting season would be avoided during maintenance so any impacts would be temporary (generally limited to the 3 year construction period) and localized to the segment of beach where disposal occurred during nesting season. These findings will be coordinated with the USFWS in our Biological Assessment included in the EIS.

10. USFWS COMMENT: The Corps should coordinate with the National Marine Fisheries Service to develop procedures to avoid adverse impacts to marine mammals that may occur in the area of the offshore borrow sites.

CORPS RESPONSE: Noted. A Biological Assessment is included in the EIS and has been coordinated with the NMFS. Their concurrence has been provided.

11. USFWS COMMENT: The project should include a monitoring program on beach and subtidal invertebrates that form an important food resource for

shorebirds. The project should include a requirement for a pre-project assessment of beach invertebrate biomass and community composition, i.e., the number of species present. The program should have adequate control areas such as the Cape Hatteras National Seashore just south of the project area. There should be an additional requirement to quantify changes in biomass and community composition at one, three, five, and ten years after initial construction. If any assessment indicates a significant decline in either biomass or the number of species present when compared to control areas, there should definite procedures in place to develop mitigation for this community.

CORPS RESPONSE: Due to resource agency concern regarding uncertainties of the potential impacts of disposal of sand on the beach during the summer months (for construction only) and long term impacts of repeated beach disposal year-round, some additional monitoring is justified. The Corps will address these issues through the development of an integrated monitoring plan as described in section 6.12.2.

12. USFW COMMENT: The Magnuson-Stevens Fishery Conservation and Management Act and Sustainable Fisheries Act of 1996 (Public Law 104-297) requires that essential fish habitat (EFH) be identified. The Service believes that over the 50-year life of the project, some or all of both nearshore or offshore areas impacted by this project may be designated as EFH. The Corps must consult with the National Marine Fisheries Service regarding the impact of the proposed project on those species for which the proposed borrow sites and adjacent areas have been determined to constitute Essential Fish Habitat (see references, Appendix B, Table 1).

Although the study area has not been formally designated as EFH for anadromous species, management councils are mandated to comment to the Corps regarding the impact of the proposed project on those species. Therefore, the New England, Mid-Atlantic and South Atlantic Fishery Management Councils, as well as the Atlantic States Marine Fisheries Commission, should be contacted and provided with an opportunity to review the Corps' draft environmental document for the proposed project.

The consultation process in the Southeast Region of the NMFS is addressed in NMFS (1999). As noted in the Introduction and Table 1 of Appendix B, the study area has been designated as EFH for species other than those addressed herein through the analysis of data from Cooperative Winter Tagging Cruises. NMFS (1999) contains a list of the species managed by the SAFMC and NMFS, their EFH, and the geographically defined Habitat Areas of Particular Concern (HAPC) identified in Council Fishery Management Plans. In North Carolina, the SAFMC identified the sandy shoals of Cape Hatteras, not too distant from the study area, as an HAPC.

Consultation requirements in the Magnuson-Stevens Fishery Conservation and Management Act direct federal agencies to consult with NMFS when any of their activities may have an adverse effect on EFH (NMFS 1999; see also NOAA 1999 for information on the NMFS northeast region). The EFH rules define an adverse effect as "any impact which reduces quality and/or quantity of EFH...[and] may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species' fecundity), site-specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions." Since the proposed project would result in the removal from the study area of an estimated 88.7 million cy of substrate during the course of the proposed 50-year project life, it would appear that it meets the criteria for constituting an adverse effect. The Corps should contact the Southeast Region of NMFS for that purpose.

CORPS RESPONSE: The EIS will include an assessment of project impact on EFH. This assessment will be coordinated with the NMFS Southeast Region. Additional copies of the report will be provided to the NMFS for EFH coordination upon request.

13. USFWS COMMENT: Dredging should leave a sufficient layer of sediment that matches as closely as possible the original surface layer to avoid exposing a dissimilar sediment.

CORPS RESPONSE: Surface sediments in the borrow area are expected to change due to infilling from sedimentation and side sloughing. The material contained within the potential borrow areas is completely compatible with the native beach sands and meets the less than 10 percent silt and clay criteria. Following placement, wave action and natural sorting of the material will result in a sediment size distribution from the foreshore seaward to the depth of closure of the active beach profile that will mimic the sediment distribution found on the native beach.

14. USFWS COMMENT: Borrow material should be removed in thin layers over a wide area rather than from localized areas that would create numerous deep pits that are likely to refill with much finer material and permanently alter the nature of the substrate.

CORPS RESPONSE: Environmental benefits of this proposal are questionable. A wider area may reduce wave effects but would increase direct impacts to benthic organisms. Impacts on waves from a maximum cut were found to be minor. Depth of cut would depend on type of dredge used. A pipeline dredge takes a deeper cut while a hopper dredge take a shallower cut.

Project construction could be accomplished by an ocean certified pipeline dredge or a hopper dredge using direct pumpout capability. If an ocean

certified pipeline dredge is used to construct and/or nourish the project, the dredge would operate in a limited area with the depth of cut into the borrow area dictated by the operational requirements of the dredge needed to achieve maximum efficiency. In general, these dredges operate at maximum output when the depth of cut approaches the diameter of its cutterhead (generally 6 to 8 feet). Since beach compatible sediments throughout the potential borrow areas are located within 5 to 15 feet of the ocean floor, depths in any one section of the borrow area would not be greater than 5 to 15 feet deeper than the surrounding natural bottom. Hopper dredges, on the other hand, would remove shallow cuts (3 to 4 feet) over a wide area. While shallow cuts over a wide area may avoid the creation of numerous pits, the bottom area disturbed during a given operation would be greater than that associated with a pipeline dredge.

15. USFWS COMMENT: The Corps should consider dividing the entire target beach into nine sections and establishing a sequence of work for placing sediment of one-third of the sections each year. Year one would use sections 1, 4, and 7; year two would use sections 2, 5, and 8; and year three would use sections 3, 6, and 9. After three years the process would be repeated.

CORPS RESPONSE: The division of the project into construction and nourishment sequences was based on expected project performance requirements, economic considerations including the financial capability of the non-Federal sponsor, and environmental impacts. Currently, we are planning to construct the project in four approximately equal phases in terms of shoreline length and volume requirements. The phases would be as follows: (1) Kitty Hawk and Kill Devil Hills, (2) Nags Head-north segment, (2) Nags Head-south segment, and (4) South Nags Head.

16. USFWS COMMENT: Borrow areas should be seaward of the active shoreface of the beach and sand sources on the Outer Continental Shelf should be considered in order to avoid any significant changes in the bathymetry over which waves approach project area beaches.

CORPS RESPONSE: The potential borrow areas are located in water depths ranging from 40 to 50 feet, well outside the active littoral zone. Outer Continental Shelf sites were not considered since closer suitable sites are available that are seaward of the active shoreface. Wave impacts from excavation of proposed sites were found to be minor

17. USFWS COMMENT: Existing offshore sand shoals or sand bars should not be removed for use in creating the beach-dune system.

CORPS RESPONSE: The potential borrow areas do not include offshore sand shoal or bars.

18. USFWS COMMENT: The project EIS should include an analysis of changes in wave patterns and wave energy striking the shoreline that would occur as a result of removing sand from the offshore borrow pits. The analysis should determine the effect that changes in the offshore bathymetry would have on wave energy reaching the beaches and the possibility for even greater rates of shoreline recession. This analysis should specifically discuss the condition that would exist in the 50th year of the project when as much as 30 feet of sediment may have been removed from some offshore areas.

CORPS RESPONSE: Wave transformation analyses were performed for the existing offshore bottom condition and the with project condition. The with project condition simulated depths in the potential borrow areas at the end of the 50-year project life. These wave transformation analyses were performed to determine the impact of sediment removal on wave energy along the study area shoreline and associated impact on sediment transport. The results of the wave transformation analyses were used to determine sediment transport rates in the area for the with/without project conditions. For the with project condition (potential borrow areas dredged to their maximum extent), sediment transport rates were found to be slightly higher than the without project conditions along the southern extremities of the project area. However, sediment transport rates were unchanged in areas one mile south of the project area.

19. USFWS COMMENT: The EIS should fully discuss: (1) the potential rates of sediment losses from the beach fill using data on the various grain sizes available (the Sand Suitability Analysis); (2) the likely pathways that may carry as much as 1.5 million cubic yards of sand per year for 50 years away from the beach; and, (3) the likely locations that would ultimately receive the sediment carried away from the beach.

CORPS RESPONSE: The EIS includes a complete discussion of the impacts of the project on sediment transport potentials along the Dare County shorelines north of Oregon Inlet. A summary of the results of the wave transformation analysis (mentioned above) and shoreline response modeling are included in this discussion. The Corps of Engineers is not aware of the source for the sediment transport quantities mentioned in the FWS comments (1.5 million cubic yards per year over 50 years). Only minor (about 10%) increases in average potential net sediment transport would occur when all proposed borrow areas are fully excavated.

20. USFWS COMMENT: In light of the serious difficulties that the Corps has had in maintaining the important navigation channel at Oregon Inlet (USACOE 1999), the EIS should present a plan for dredging the additional sand that will be carried to the Oregon Inlet navigation channel. This plan should consider the feasibility of adding the additional dredging costs to the storm damage reduction project. In order to avoid delays in responding to

any closure of the navigation channel, a Memorandum of Agreement should be signed by the Corps, Service, NPS, and the Dare County government that clearly establishes the procedures to be used and the methods of funding for emergency dredging. An EIS without such a plan and a MOA to ensure its implementation would be inadequate.

CORPS RESPONSE: The wave transformation/sediment transport analyses mentioned above do not indicate only minor increase (about 13%) in sediment transport to Oregon Inlet as a result of the construction of the Dare County Beach storm damage reduction project. Increases in sediment transport rates extend about 1-2 miles from the terminus of the fill due to changes in shoreline orientations associated with the fill. Beyond 2 miles from the ends of the fill, the orientation of the shoreline will remain the same as under existing conditions. Given the same wave environment, storm conditions, tides, and shoreline alignment, any additional littoral transport will be minor. The scenario outline in the FWS comment cannot be supported by engineering analysis and a MOA is not proposed.

21. USFWS COMMENT: There are no conservation measures that can be associated with the current project to address the impacts of additional population growth and development. If the current project conveys the idea that a firm commitment has been made to halt beach recession, increased development will occur near the beach.

CORPS RESPONSE: It is expected that continued development will occur with or without the proposed project. Under the future without project condition, long-term erosion removes homes, motels and other accommodations from the structural database. Other things being equal, this would effectively decrease annual visitation. However, given the ever increasing demand for beach vacations and second homes on the coast, it is not likely that these lost properties would lead to any net loss in visitation. A more likely scenario is that the properties that would be lost to erosion would be replaced by more public parking, and new motels and homes would replace older ones along the second row of development from the ocean to meet the demand for accommodations with a view of the ocean.

8.03 Required Documentation

The DEIS for this project was circulated for 45 days. Comments were considered in preparation of this Final Environmental Impact Statement (FEIS), and specifically responded to in Attachment C of this document.

The U.S. Department of the Interior, Fish and Wildlife Service, and the U.S. Department of Commerce, National Marine Fisheries Service, have reviewed the Corps Biological Assessment contained herein under Section 7(c) of the Endangered Species Act of 1973, as amended. NMFS has concurred with the

findings in the assessment. The USFWS will provide a Biological Opinion after review of the FEIS.

The cultural resources assessment contained herein was provided to the North Carolina Division of Archives and History, Underwater Archaeology Unit, the North Carolina State Historic Preservation Officer and the Advisory Council on Historic Preservation, pursuant to the National Historic Preservation Act of 1966, as amended, implemented by regulations found at 36 CFR 800. Concurrence in our findings has been provided.

A Federal consistency determination pursuant to the Federal Coastal Zone Management Act of 1972, as amended, is included in this FEIS and is being furnished to the State of North Carolina for its review and concurrence.

The NED plan alternative involves discharges of fill material into the waters of the United States. A Final Section 404 (b)(1) evaluation (P.L. 95-217) has been prepared and is attached to this document as Attachment A. A Final 404 (b) Public Notice will be circulated concurrent with the FEIS. A Section 401 water quality Certificate will be requested from the State of North Carolina concurrent with circulation of the FEIS.

Coordination of this Document. This FEIS is being provided to a standard list of Federal, State, and local agencies; elected officials; environmental groups; and known interested individuals for review and comment. After a 30-day review period, all input received will be considered in preparation of the Record of Decision.

We invite your comments and suggestions regarding the proposed action. In accordance with Council on Environmental Quality regulations (40 CFR 1500-1508) for implementing the National Environmental Policy Act (NEPA), your comments should be as specific as possible and should be made with recognition that NEPA documents must focus on the issues that are truly significant to the proposed action rather than amassing needless detail. The NEPA process is intended to help public officials make decisions based upon an understanding of environmental consequences. NEPA directs that Federal activities be conducted so as to attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable or unintended consequences. As individual resources and stakeholder interests increasingly compete for priority, public officials are challenged to make management decisions that reflect a balance of the overall public interest. Please respond with a focus on essential issues that will be useful in guiding our decisions and actions as the Dare County Beaches project proceeds. Statement recipients are listed in Table 8-1

TABLE 8-1. RECIPIENTS OF THIS FEIS

Representatives

Honorable Walter B. Jones, Jr.
Honorable Jesse Helms
Honorable John Edwards
Honorable Marc Basnight
Honorable William T. Culpepper, III

Federal Agencies

U.S. Environmental Protection Agency, Office of Federal Activities
U.S. Environmental Protection Agency, Region IV, Atlanta, Ga.
U.S. Environmental Protection Agency, NEPA Compliance Division, Washington, DC
USDA, Forest Service, State & Private Forestry, Southern Region, Atlanta, GA
U.S. Department of Interior, Environment, Attn: Terry Martin, Policy & Compliance, Washington, DC
U. S. Department of Interior, Atlanta, GA
U.S. Department of Energy, Office of Environmental Compliance, Washington, DC
U.S. Geological Survey, 2255 North Gemini, Flag Staff, AZ 86001
HUD, Office of Environmental Quality, Washington, DC
HUD, Environmental Officer, Atlanta Regional Office
Director, Ecology & Conservation Office, HCHB, SP, Washington, DC
Executive Director, Advisory Council on Historic Preservation, Washington, DC
U.S. Department of Commerce, NOAA, Herbert Hoover Bldg, Washington, DC
U.S. Department of Commerce, NOAA Office of Policy & Strategic Planning, Washington, DC
Center for Disease Control, Special Programs, Atlanta, Ga.
National Marine Fisheries Service, Habitat Conservation Division, Beaufort, NC
National Marine Fisheries Service, South Atlantic Fishery Mgt. Council, Charleston, SC
National Marine Fisheries Service, Mid-Atlantic Fishery Mgt. Council, Dover, Delaware
National Marine Fisheries Service, Attn: Mr. David Rackley, Charleston, SC
U.S. Fish & Wildlife Service, Raleigh Field Office, Raleigh, NC
U.S. Fish & Wildlife Service, Asheville Field Office, Asheville, NC
U.S. Fish & Wildlife Service, South Atlantic Fisheries Coordination Office, Raleigh, NC
U.S. Fish & Wildlife Service, Wildlife Habitat Management, Manteo, NC
U.S. Fish & Wildlife Service, Pea Island National Wildlife Refuge, Manteo, NC
U.S. Fish & Wildlife Service, Alligator River National Wildlife Refuge
Commander, Fifth Coast Guard District, Federal Bldg, Portsmouth, VA
U.S. Department of Transportation, Environment & Policy Review, Washington, DC
U.S. Department of Transportation, Federal Highway Admin., Raleigh, NC
National Park Service, Attn: Mr. Dominic Dottavio, Atlanta, GA

National Park Service, Attn: Mr. Albert G. Greene, Jr., Washington, DC
National Park Service, Southeast Regional Director, 100 Alabama St., SW, Atlanta, GA
National Park Service, Superintendent, Cape Hatteras National Seashore, Manteo, NC
USAF, Seymour Johnson AFB
NOAA, Ms. Susan Fruchter, Herbert Hoover Bldg., Washington, DC

State Agencies

North Carolina State Clearinghouse
North Carolina Division of Coastal Management
North Carolina Wildlife Resources Commission, Attn: Ruth Boettcher, Marshallberg, NC
Billy Gray, CAMA Officer, Town of Kill Devil Hills
Daniel Smith, CAMA Officer, Kitty Hawk
North Carolina Dept. of Environment & Natural Resources, Consistency Coordinator, Division of Coastal Management, Raleigh, NC
North Carolina Aquarium at Fort Fisher, Attn: Andy Wood, Kure Beach, NC

Local Government

Dare County Building Inspector, Manteo, NC
Chairman, Dare County Oregon Inlet and Waterways Commission, Manteo, NC
Chairman, Dare County Commissioners, Manteo, NC
Chairman, Dare Soil & Water Conservation Division, Manteo, NC
Mayor, Town of Manteo
Registrar of Deeds, Dare County, Manteo, NC
Town Manager, Town of Nags Head, NC
Town Manager, Kitty Hawk, NC
Town Manager, Kill Devil Hills, NC

Independent Groups and Individuals

Environmental Defense Fund of North Carolina, Raleigh, NC
Etheridge Fish Company
NCSU, Dept. of Marine/Earth & Atmos. Sci, College of Physical & Math Sciences, Raleigh, NC
North Carolina Coastal Federation, Newport, NC
Bateman Oil Company, Belhaven, NC
National Audubon Society, Wilmington, NC
Mr. John C. Babicz, Woodbridge, VA
Dr. Vince Bellis, Greenville, NC
Mr. Ray P. Brandi, Cape Fear Community College, Wilmington, NC
Southern Environmentl Law Center, Chapel Hill, NC 27516
Mr. Kenny L. Daniels, Hampton, VA

Dr. Robert G. Dean, Coastal & Oceanographic Engr., Gainesville, FL
Sierra Club, Attn: Molly Diggins, NC Chapter, Raleigh, NC
Director, North Carolina Industrial Park, Wanchese, NC
Dr. Robert Dolan, University of Virginia, Charlottesville, VA
Mr. Tom Drake, NC State University, Raleigh, NC
Mr. Willie Etheridge, Wanchese, NC
Executive Director, North Carolina Coastal Federation, Newport, NC
Mr. Dick Farrow, Frisco Contractors, Frisco, NC
Mr. Hiram C. Gallop, Wanchese, NC
Mr. Michael Halminski, Waves, NC
Mr. Sidney Maddock, Buxton, NC
Mr.Orman L. Mann, Wanchese, NC
Col. Daniel E. McDonald (Ret), Consultant to Governor on Oregon Inlet, Raleigh, NC
Ms. Karen Merritt, Rodanthe, NC
Dr. John Miller, NCSU, Zoology Dept., Raleigh, NC
Mr. D. S. Oden, Jr., Hatteras, NC
Dr. Orrin G. Pilkey, PhD, Dept. of Geology, Durham, NC
President, Colington Harbor Association, Inc., Kill Devil Hills, NC
Mr. Jerry F. Schill, Exec. Director, NC Fisheries Association, New Bern, NC
Mr. Judy Smith, CSU Library, Ft. Collins, CO
Mr. Gilbert Tillett, Wanchese, NC
Mr. Rondal K. Tillett, Wanchese, NC
Ms. Cathy Tollerton, Defenders of Wildlife, Washington, DC
Mr. Ed Welch, c/o Passenger Vessel Assoc., Arlington, VA
Mr. John Whitehead, ECU, Dept. of Economics, Greenville, NC
Mr. Bob Peele, PO Box 549, Wanchese, NC
Cary Selberg, Atlantic States Marine Fisheries Commission, Washington, DC
Roger Pugliese, South Atlantic Fisheries Council, Charleston, SC
Ms. Celeste Maus, Wilmington, NC
Ms. Gwendelyn Wiscott, Camden, NC
Dr. Bill Cleary, UNCW Dept. of Earth Sciences, Wilmington, NC
Dr. Martin Posey, UNCW Dept. of Biological Sciences, Wilmington, NC
The Wilderness Society, Washington, DC
Funds for Animals, New York, NY
Mr. Paul Friesema, Northwestern University, Evanston, Il.
Mr. Bill Kollman, 17000 Jefferson Davis Hwy, Colonial Heights, VA 23834

Postmasters

Avon
Buxton
Manteo
Hatteras
Stumpy Point
Wanchese
Nags Head

Kitty Hawk
Kill Devil Hills

Newspapers

The Coastland Times, Manteo
The Outer Banks Current, Accomac, VA
Virginia Pilot

Libraries

N.C. Collection, Wilson Library, UNC-Chapel Hill
N.C. Dept. of Environment, Health and Natural Resources
Randall Library, UNW-Wilmington
State Library of North Carolina
Joyner Library, East Carolina University
Dare County Library

9.00 LIST OF PREPARERS

The following people provided major support in the development and preparation of this final environmental impact statement.

NAME (FEIS Role)	EXPERTISE	EXPERIENCE	DISCIPLINE
Chuck Wilson FEIS Preparation	Env. Impact Assessment	21yrs., Env. Resources Sec. Wilm. Dist.	Marine Biology
Gene Griffin FEIS Supervision	Water Resources & Env. Planning	35 yrs., USACE 4 yrs., Priv. Consul.	Landscape Architecture
Coleman Long Plan & Environmental Supervision	Planning & Environmental	26 yrs., Env. Resources and Planning, Wilm. Dist.	Landscape Architecture
Sharon Haggett PE Project Management	Project Management	1 yrs. , Project Management. 6 yrs. Design Br, 3 yrs Const. 4 yrs. Consultant	Civil Engineering
Bill Dennis PE Shore Processes	Coastal Design	23 yrs., Coastal Engineering Wilm. Dist	Coastal Engineering
Tom Jarrett Eng. Supervision	Coastal Design Supervision	30 yrs., Coastal H & H Section, Wilm. Dist.; 1.5 yrs., Research Hydraulic Engineer, WES	Coastal Engineering
Doug Quinn PE Project Engineer	Coastal	29 yrs, H&H Section, 1 yr Coastal Wilm. Dist.	Coastal Engineering
Bob Finch Economic Analysis	Economic & Social Analysis	25 yrs., Econ. & Soc. Anal. Wilm. Dist.	Economics & Water Resources
Richard Kimmel Cultural Resources	Historical & Underwater Archaeology	22 yrs., Env. Resources Sec., 1.5 yrs., Univ. S.Carolina	Anthropology
Ben Lackey Geotechnical	Geotechnical Analysis	21 Years GeoTech Sec., 1Yr. Cost Eng. Wilm Dist.	Civil Geotech Engineer
Ted Zielonka Project Geologist	Geology & Geophysics	22 yrs. Eng Geologist	Engineering Geology
Carrol Niesen PE Cost Engineering	Cost Engineering	5 yrs Cost Eng., 8 yrs Planning, 8 yrs Design Wilm Dist. 1 yr. EPA	Civil Engineer
Mike Wutkowski PE Modeling	Coastal Engineering Modeler	23 Years Coastal Engineering	Coastal
Brooke Lamson Legal Counsel	Law Attorney	15 Years, Office of Counsel, Wilm. Dist.	Legal

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11.00 INDEX

11.00 INDEX (continued)

ATTACHMENT A

Dare County Beaches (Bodie Island Portion) Hurricane Protection and Beach Erosion Control Project
Dare County, North Carolina

Evaluation of Section 404 (b) (1) Guidelines 40 CFR 230

DARE COUNTY BEACHES (BODIE ISLAND PORTION), NORTH CAROLINA
Final Evaluation of Section 404 (b) (1) Guidelines 40 CFR 230

This evaluation of the placement of any and all fill material into waters and wetlands of the United States required for construction and maintenance of the Dare County Beaches Project, North Carolina.

Section 404 Public Notice No. CESAW-TS-PE-00-28-0008 *Updated

		Preliminary 1/	Final 2/
1.	Review of Compliance (230.10(a)-(d)) A review of the NEPA Document indicates that:		
a.	The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose (if no, see section 2 and NEPA document);	YES|X| NO|_|*	YES|X| NO|_|
b.	The activity does not: 1) violate applicable State water quality standards or effluent standards prohibited under Section 307 of the CWA; 2) jeopardize the existence of federally listed endangered or threatened species or their habitat; and 3) violate requirements of any federally designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies);	YES|X| NO|_|*	YES|X| NO|_|
c.	The activity will not cause or contribute to significant degradation of waters of the U.S. including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values (if no, see section 2);	YES|X| NO|_|*	YES|X| NO|_|
d.	Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see section 5).	YES|X| NO|_|*	YES|X| NO|_|

Proceed to Section 2

*, 1, 2/ See page 6.

2. Technical Evaluation Factors (Subparts C-F)	N/A	Insignificant	Significant*
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)			
(1) Substrate impacts.		X	
(2) Suspended particulates/turbidity impacts.		X	
(3) Water column impacts.		X	
(4) Alteration of current patterns and water circulation.		X	
(5) Alteration of normal water fluctuations/hydroperiod.		X	
(6) Alteration of salinity gradients.	NA		
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D)			
(1) Effect on threatened/endangered species and their habitat.		X	
(2) Effect on the aquatic food web.		X	
(3) Effect on other wildlife (mammals, birds, reptiles, and amphibians).		X	
c. Special Aquatic Sites (Subpart E)			
(1) Sanctuaries and refuges.	NA		
(2) Wetlands.	NA		
(3) Mud flats.	NA		
(4) Vegetated shallows.	NA		
(5) Coral reefs.	NA		
(6) Riffle and pool complexes.	NA		
d. Human Use Characteristics (Subpart F)			
(1) Effects on municipal and private water supplies.	NA		
(2) Recreational and commercial fisheries impacts.		X	
(3) Effects on water-related recreation.		X	
(4) Aesthetic impacts.		X	
(5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.		X	

Remarks: Where a check is placed under the significant category, preparer add explanation below.

Proceed to Section 3

*See page 6.

3. Evaluation of Dredged or Fill Material (Subpart G) 3/

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material. (Check only those appropriate.)

(1) Physical characteristics. . . . . |X|
(2) Hydrography in relation to known or anticipated sources of contaminants . . . . . |X|
(3) Results from previous testing of the material or similar material in the vicinity of the project . . . . . | |
(4) Known, significant sources of persistent pesticides from land runoff or percolation . . . . . |_|
(5) Spill records for petroleum products or designated (Section 311 of CWA) hazardous substances . . . . . |_|
(6) Other public records of significant introduction of contaminants from industries, municipalities, or other sources. . . . . |_|
(7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities. . . . . |_|
(8) Other sources (specify). . . . . |_|

List appropriate references.

Reference: Final Environmental Impact Statement,Dare CountyBeaches Project,North Carolina, dated September 2000.

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or that levels of contaminants are substantively similar at extraction and disposal sites and not likely to result in degradation of the disposal site.** YES |X| NO |_|*

Proceed to Section 4
*, 3/, see page 6.

4. Disposal Site Determinations (230.11(f)).

a. The following factors as appropriate, have been considered in evaluating the disposal site.

(1) Depth of water at disposal site. . . . . |X|

(2) Current velocity, direction, and variability at disposal site . . . . . |X|

(3) Degree of turbulence. . . . . |X|

(4) Water column stratification . . . . . |X|

(5) Discharge vessel speed and direction . . . . . |X|

(6) Rate of discharge . . . . . |X|

(7) Dredged material characteristics (constituents, amount and type of material, settling velocities). . . . . |X|

(8) Number of discharges per unit of time. . . . . |X|

(9) Other factors affecting rates and patterns of mixing (specify)

List appropriate references.

Reference: Final Environmental Impact Statement, Dare County Beaches Project, North Carolina, dated September 2000.

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable. YES |X| NO |_|*

5. Actions to Minimize Adverse Effects (Subpart H).

All appropriate and practicable steps have been taken, through application of recommendations of 230.70-230.77, to ensure minimal adverse effects of the proposed discharge. List actions taken. YES |X| NO |_|*

See Section 6.07 of the FEIS for water quality.
See Section 6.04 of the FEIS for benthos.
See Section 6.04 of the FEIS for fisheries.
See Section 6.09 of the FEIS for threatened and endangered species.

Return to section 1 for final stage of compliance review. See also note 3/, page 3.
*See page 6.

6. Factual Determinations (230.11).

A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:

a. Physical substrate at the disposal site (review sections 2a, 3, 4, and 5). YES |X| NO |_|*

b. Water circulation, fluctuation, and salinity (review sections 2a, 3, 4, and 5). YES |X| NO |_|*

c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5). YES |X| NO |_|*

d. Contaminant availability (review sections 2a, 3, and 4). YES |X| NO |_|*

e. Aquatic ecosystem structure and function (review sections 2b and c, 3, and 5). YES |X| NO |_|*

f. Disposal site (review sections 2, 4, and 5). YES |X| NO |_|*

g. Cumulative impact on the aquatic ecosystem. YES |X| NO |_|*

h. Secondary impacts on the aquatic ecosystem. YES |X| NO |_|*

7. Findings.

a. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines. . . . . |X|

b. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines with the inclusion of the following conditions:. . . . . |_|

c. The proposed disposal site for discharge of dredged or fill material does not comply with the Section 404(b)(1) guidelines for the following reasons(s):

(1) There is a less damaging practicable alternative . . . . . |_|

(2) The proposed discharge will result in significant degradation of the aquatic ecosystem . . . . . |_|

*See page 6.

(3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem. . . . . |_|

8.

James W. DeLony
Colonel, U.S. Army
District Engineer

Date: 24 Sep 00

*A negative, significant, or unknown response indicates that the permit application may not be in compliance with the Section 404(b)(1) Guidelines.

1/ Negative responses to three or more of the compliance criteria at this stage indicate that the proposed projects may not be evaluated using this "short form procedure." Care should be used in assessing pertinent portions of the technical information of items 2 a-d, before completing the final review of compliance.

2/ Negative response to one of the compliance criteria at this stage indicates that the proposed project does not comply with the guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short form evaluation process is inappropriate."

3/ If the dredged or fill material cannot be excluded from individual testing, the "short-form" evaluation process is inappropriate.

ATTACHMENT B

Dare County Beaches (Bodie Island Portion) Hurricane Protection and Beach Erosion Control Project
Dare County, North Carolina

Cultural Resources Survey

A Phase I Upland and Underwater Archaeological Survey of the Dare County Beaches and Borrow Areas, North Carolina

Contract Number:
DACW54-99-P-3057
and
DACW54-97-P-3416

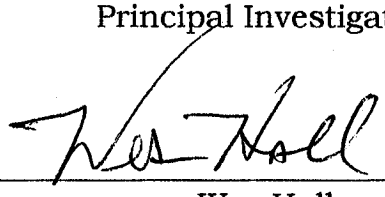
Submitted To:

U.S. Army Corps of Engineers
Wilmington District

Submitted By:

Mid-Atlantic Technology and Environmental Research, Inc.

Principal Investigator:



Wes Hall

6 March 1999

A Phase I Upland and Underwater Archaeological Survey of the Dare County Beaches and Borrow Areas, North Carolina

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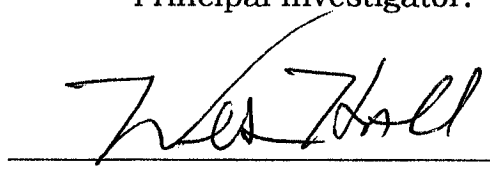

Wes Hall

6 March 1999

ABSTRACT

The U.S. Army Corps of Engineers, Wilmington District, is preparing to re-nourish Dare County beaches using sand from proposed borrow areas situated in the Atlantic Ocean, off the contiguous towns of Nags Head, Kill Devil Hills, and Kitty Hawk. The re-nourishment project will include approximately 20 miles of beach, beginning just north of Oregon Inlet and ending at the town of Kitty Hawk. Sand will be borrowed from three areas totaling approximately 20 square miles of ocean bottom.

Numerous historic shipwrecks are known to have occurred along the Outer Banks, many of which have been reported near the Dare County beach re-nourishment project. To insure that no significant shipwrecks or other archaeological resources are adversely effected by the planned offshore dredging and beach reconstruction, the Wilmington District contracted Mid-Atlantic Technology and Environmental Research, Inc. of Castle Hayne, North Carolina, to conduct an archaeological survey of the effected beach and borrow areas. The archaeological survey included marine remote sensing using a marine magnetometer and side-scan sonar to identify any submerged cultural resources within the proposed borrow areas. The archaeological survey also included a terrestrial reconnaissance along Dare County beaches to identify any exposed shipwreck remains. Field investigations for the project were conducted in two parts and under two separate contracts. The first portion of the survey was conducted between 19 and 30 July 1997 and included a remote sensing survey of four areas called E, C, B, and A. The second portion of the survey was carried out between 15 November and 30 December 1998. The added areas were mostly contiguous with and expanded areas E, C, B, and A. The new areas were called 1, 2, 3, and 4, and resulted in 3 individual borrow areas.

As a result of the remote sensing survey, only three (3) single-source magnetic anomalies were identified within the borrow areas. No acoustic targets were identified. Because a significant number of vessels have been lost near the inlet, potentially all of the magnetic anomalies might be associated with a historic shipwreck. However, single isolated objects of modern or historic origin seldom have the potential to meet the criteria for nomination to the National Register of Historic Places.

During the 1997 and 1998 field season, no archaeological sites were observed on the beach within the proposed nourishment area. Near shore or beach wrecks are most frequently exposed during winter months or following storms. Because exposure of potential wrecks sites in the vicinity of the proposed beach re-nourishment project is a transient phenomenon, the North Carolina Department of Cultural Resources has recommended that additional investigations take place within a few months of project construction. These investigations will likely be conducted by State and U.S. Army Corps of Engineers Staff, or will be conducted under their supervision.

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INTRODUCTION

The U.S. Army Corps of Engineers, Wilmington District, is preparing to re-nourish Dare County beaches using sand from proposed borrow areas situated in the Atlantic Ocean, off the contiguous towns of Nags Head, Kill Devil Hills, and Kitty Hawk. The re-nourishment project will include approximately 20 miles of beach, beginning just north of Oregon Inlet and ending at the town of Kitty Hawk. Sand will be borrowed from three areas totaling approximately 20 square miles of ocean bottom. Numerous historic shipwrecks are known to have occurred along the Outer Banks, many of which have been reported near the Dare County beach re-nourishment project. To insure that no significant shipwrecks[1] or other archaeological resources are adversely effected by the planned offshore dredging and beach reconstruction, the Wilmington District contracted Mid-Atlantic Technology And Environmental Research, Inc. (M-AT/ER) of Castle Hayne, North Carolina, to conduct an archaeological survey of the effected beach and borrow areas. The archaeological survey included marine remote sensing using a marine magnetometer[2] and side-scan sonar[3] to identify any submerged cultural resources within the proposed borrow areas. The archaeological survey also included a terrestrial reconnaissance along Dare County beaches to identify any exposed shipwreck remains.

The project was conducted in two parts and under two separated contracts. The first portion of the survey was conducted between 19 and 30 July 1997 and included a remote sensing survey of four areas called E, C, B, and A. The second portion of the survey was conducted between 15 November and 30 December 1998. The added areas were mostly contiguous with and

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[1] A National Policy for historic preservation has been established in accordance with authorization contained in Section 106 and 110 (formerly E.O. 11593) of the National Historic Preservation Act of 1966 as amended following the Advisory Council on Historic Preservation Regulations (36 CFR 800). Executive Order 11593 and the Historic Preservation Act Amendments of 1980 specified that the Federal Government shall provide leadership in preserving, restoring, and maintaining the historic and cultural environment of the nation. In 1988, Abandoned Shipwreck Act (Public Law 100-298) declared that the States (or Territories of the U.S.) are to manage shipwrecks in States waters. As a result of these and other legislation, state and Federal agencies are required to administer cultural properties under their control in a spirit of stewardship and trusteeship. Each agency is required to initiate such measures as are necessary to insure that policies, plans, and programs will preserve sites, structures, and objects of historical or archaeological significance that exist on properties owned by the Federal Government or are subject to Federal regulation.

[2] A magnetometer is an electronic instrument that measures localized changes in the the earth's magnetic field. By using a magnetometer in a controlled survey, the presence of ferrous materials can be detected. Since most historically significant shipwrecks contain relatively large amounts of iron or steel in the form of fasteners, anchors, cannon, or engines, etc., their presence can frequently be detected by a magnetometer survey.

[3] Side-scan sonar is an underwater acoustic instrument that by electronic means generates a graphic representation of the bottom surface. By interpretation of these graphic records, the user can identify geographic changes in the bottom or man-made objects protruding above the bottom surface.

expanded areas E, C, B, and A. The new areas were called 1, 2, 3, and 4, and resulted in 3 individual borrow areas. (When it was determined that additional sand was need to complete the beach re-nourishment project, a second survey was conducted so that the size of the original borrow areas could be expanded.)

In addition to the archaeological survey, bottom surface mapping using side-scan sonar was performed to identify "hard bottom areas."

PROJECT LOCATION: 1997 SURVEY

The four borrow areas surveyed in July 1997 were situated between 3,000 and 15,000 feet offshore (Figure 1). Area E was a six-sided polygon with a maximum length of approximately 20,000 feet and maximum width of approximately 8,200 feet. Area E was located parallel to and approximately 7,000 feet off the beach at Nags Head.

Area C was a six-sided reversed L-shaped area. The leg of the "L" was 10,400 feet long by 1,200 feet wide. The foot of the reversed L-shaped area was approximately 4,500 feet wide by 5,000 feet long. Area C was located approximately 5,500 feet off the beach between the towns of Kitty Hawk and Kill Devil Hills.

Area B also was a six-sided reversed L-shaped area. The leg of the "L" was 3,000 feet long by 2,200 feet wide. The foot of the "L" was 4,200 feet long by 2,000 feet wide. Area B was positioned 5,500 feet off the town of Kitty Hawk.

Area A was a long, narrow rectangular area 9,200 feet long by 1,150 feet wide, situated perpendicular to the beach and approximately 8,000 feet offshore of the Kitty Hawk Pier.

PROJECT LOCATION: 1998 SURVEY

The four offshore borrow areas 1, 2, 3, and 4 surveyed in 1998 are situated between 2,000 and 24,000 feet offshore. Area 1 is located directly east and contiguous with areas A, B, and C surveyed in 1997. Area 1 is an odd-shaped area approximately 24,000 feet long and varies in width from 100 to 6,000 feet.

Area 2 was located approximately 1,500 feet west of the north end of Area E. Area 2 is an odd-shaped area more than 5,000 feet long and approximately 3,500 feet wide.

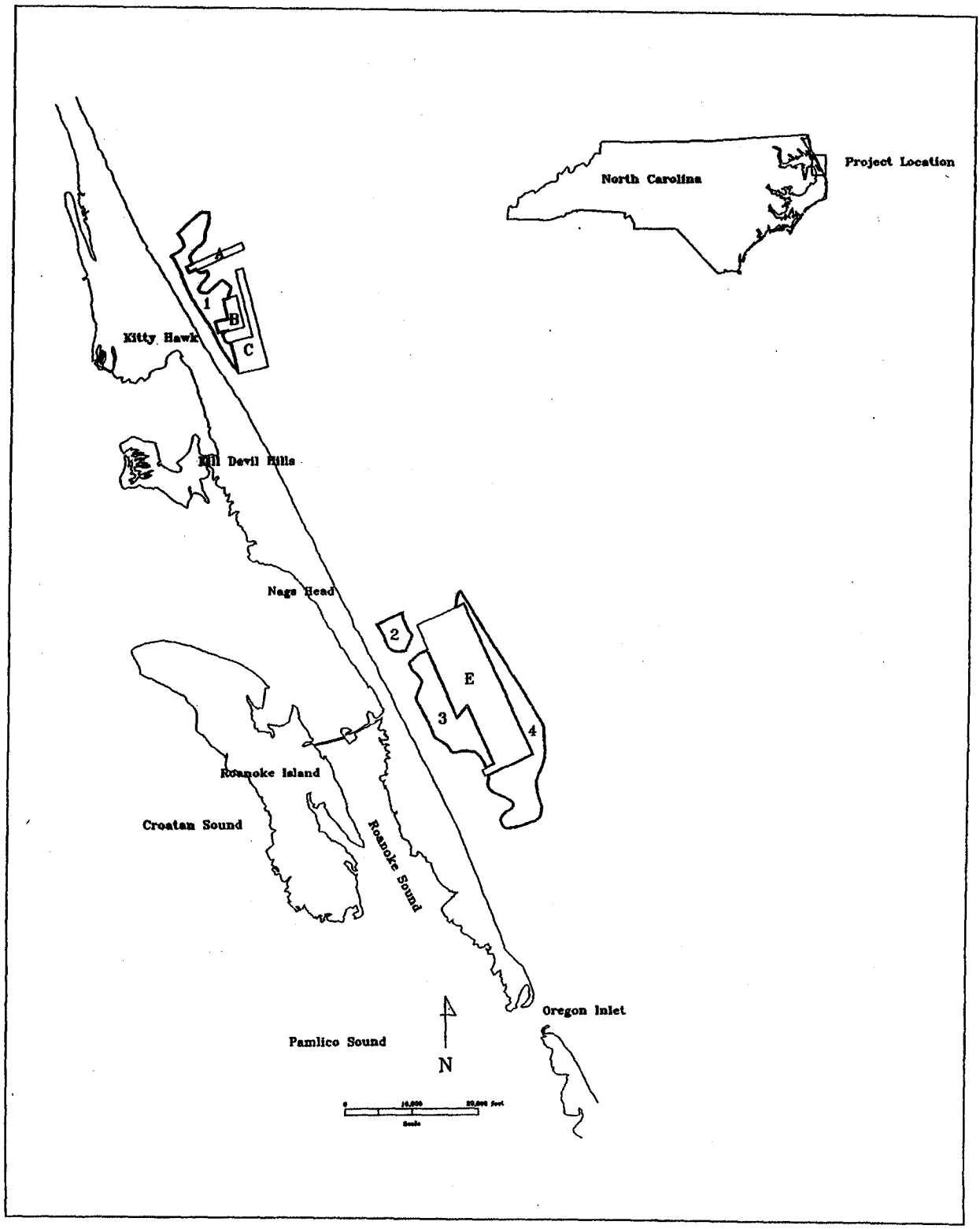

Figure 1. Project Location Map: 1997 and 1998.

Area 3 was located immediately east of Area E. Area 3 was an odd-shaped area more than 18,000 feet long and 1,200 to 6,500 feet wide. Area 4 was located immediately west of Area E.

Area 4 is more than 35,000 feet long and varies in width between 600 and more than 7,000 feet long.

DARE COUNTY BEACHES

Dare County beaches are situated on the northern portion of the coastal barrier island formation called the Outer Banks. The beach re-nourishment project is associated with the contiguous communities of Nags Head, Kill Devil Hills, and Kitty Hawk, which are located along the southern portion of Bodie Island, beginning just north of Oregon Inlet (Figure 1).

Survey Coordinates: 1997

Listed below are the North Carolina State Plane Coordinates for survey areas E, C, B, and A, which are based on the NAD 83 datum.

Area E

	Northing	Easting
1	815,608	3,011,066
2	818,874	3,018,280
3	795,640	3,028,800
4	792,217	3,021,240
5	793,455	3,020,680
6	794,346	3,022,647
7	802,999	3,018,729
8	801,164	3,017,107

Area C

	Northing	Easting
1	869,468	2,984,157
2	869,739	2,985,250
3	854,780	2,988,961
4	853,869	2,974,434
5	858,483	2,983,290
6	859,322	2,986,674

Area B

	Northing	Easting
1	865,112	2,982,192
2	865,620	2,998,423
3	860,816	2,985,431
4	859,830	2,981,455
5	861,704	2,980,990
6	862,182	2,982,918

Area A

	Northing	Easting
1	870,091	2,976,623
2	873,609	2,985,045
3	872,626	2,985,455
4	869,108	2,977,034

Survey Coordinates: 1998

Survey coordinates for Areas 1, 2, 3, and 4 were digitized directly from U.S. Army Corp of Engineers Project maps. Since the areas are odd-shaped, no corner coordinates were used to develop the survey areas.

DESCRIPTION OF WORK: 1997 AND 1998

Preliminary Investigations

Prior to beginning the archaeological survey of Dare County beaches, M-AT/ER met with the Underwater Archaeology Unit (UAU) of the North Carolina Division of Archives and History at Kure Beach. As part of the meeting, investigators discussed known wreck sites along the beaches of Nags Head, Kill Devil Hills, and Kitty Hawk. The potential for unknown wreck sites also was discussed. Numerous wrecks just offshore of the beach have been recorded, but few sightings of wreckage on the beach have been reported. These limited sightings all were reported during extreme low tides, usually during the winter months when strong northeast winds had eroded beaches and exposed the wrecks.

Beach Reconnaissance: 1997

The archaeological reconnaissance of the beach was delayed until after peak tourist season and as far into the fall season as time allowed. City ordinances allow four-wheel-drive vehicles on the beach after October 1st. The reconnaissance began at Oregon Inlet and was terminated at the Kitty Hawk Pier. A two-man team, either walking or driving the beach (with a four-wheel-drive GMC), conducted the beach reconnaissance on 6, 7, and 8 October 1997. The beach was examined from the dune line to the water at low tide. Occasionally, city lifeguards were queried about exposed wrecks and wreck sites on the beach. Lifeguards, several of whom are divers familiar with the shipwrecks near the beach, regularly patrol the beach on 4-wheelers.

Beach Reconnaissance: 1998

On 23 and 24 December 1998, a second reconnaissance was conducted by driving the beach from Oregon Inlet to Kitty Hawk Pier.

Remote Sensing Survey: 1997

M-AT/ER's underwater archaeology team conducted the remote sensing survey of the four proposed borrow areas (E, C, B, and A) from a 25-foot

survey vessel. Three remote sensing devices were used: 1) a Geometrics 886 proton precession marine magnetometer; 2) a Klein System 2000 dual-frequency, digital, side-scan sonar; and 3) an Odom Hydrographics System Echotrac DF3200MKII depth recorder. Each instrument was interfaced with a NAVSTAR™ Differential Global Positioning System. Magnetic data, along with corresponding positioning data, was recorded at one-second intervals (or approximately every 10 feet along a track line at 6 knots) using MAGSEA™ data acquisition software. A small, V-Fin cable depressor was utilized to keep the Geometrics marine sensor at an average depth of 20 feet above the bottom surface in the shallowest portions of each survey area. Variation in depth along survey lines varied as much a 20 feet in Area E. The depth of inshore survey areas A, B, and C only varied 5 to 8 feet (depending on wave action and bottom changes). Inshore survey area acoustic data, along with corresponding positioning data, was recorded continuously on paper and/or 8mm data tapes. The side-scan sonar fish was maintained at an altitude above the bottom that provided the most detailed records (generally 20 to 30 feet). Hydrographic data was recorded entirely in HYPACK™ hydrographic survey and navigation software.

Irregularly-shaped borrow areas were subdivided into rectangular areas to facilitate the survey with HYPACK navigation software. Data was collected along parallel lines spaced at 100-foot intervals throughout each borrow area. At the end of the general survey, magnetic anomalies/targets were relocated and their state plane coordinates were recorded using HYPACK.

Remote Sensing Survey: 1998

The remote sensing survey was conducted using three remote sensing devices: 1) a Geometrics 881 cesium marine magnetometer; 2) a DF-1000 EdgeTech digital, dual-frequency (100-500 kHz) side-scan sonar with a 560D Processor; and 3) a JRC precision depth recorder. Each of these instruments was interfaced with a Starlink Differential Global Positioning System. Data was collected along parallel lines spaced at 100-foot intervals. Magnetic data, along with corresponding positioning data, was recorded at one-second intervals (or approximately every 10 feet along a track line at 6 knots) using MAGSEA™ and HYPACK™ data acquisition software. A 65-pound, tri-wing cable depressor/stabilizer was used to keep the Geometrics marine sensor at a depth of approximately 20 feet above the bottom surface. Acoustic data, with corresponding positioning data, was recorded continuously using SeaSone Hunter™ acoustic data acquisition software and was stored on Jazz diskettes. Hydrographic data was recorded and is being accessed entirely with HYPACK™ hydrographic survey and navigation software.

Data was collected along parallel lines spaced at 100-foot intervals throughout each borrow area. At the end of the general survey, magnetic anomalies/targets were relocated and their state plane coordinates were recorded using HYPACK.

DESCRIPTION OF FINDINGS

Investigations to identify documented shipwrecks near the project area revealed that more than 197 ships have wrecked in the region north of Oregon Inlet.

Most of the shipwrecks occurred during the nineteenth century. However, because of the region's propensity for shipwrecks, many unrecorded wrecks could have occurred in previous centuries.

Shipwreck List

KNOWN LOCATIONS OF UNNAMED WRECKS AND WRECKAGE

Wreck Name	Type Vessel	Location
18.3 Mile South Nags Head	25' long vessel	18¼ miles S. Nags Head
Single Frame		3½ miles S. of NPS Maintenance Shop
Coquina Beach		100 yards S. of NPS Maintenance Shop
Brill Site		Mile 19 S. Nags Head
Nansemond Colony Wreck		1 mile S. Outer Banks Fishing Pier
Outer Banks Pier Site		5th house N. of Outer Banks Fishing Pier
Juncos Street		100 yards S. Junco Street Beach Access
Dune Timber		½ mile below Outer Banks Pier
Seafoam Wreck		Nags Head adjacent to Seafoam Hotel
Latham Wreck		¼ mile N. Jeannettes Pier
Nags Head Wreck II		S. of Nags Head Fishing Pier
Nags Head Wreck		Water Tower, Town Hall
Peterson I		Southern Shores just off 4th Avenue
Peterson II		Southern Shores 200 ft. S. of 4th Avenue
North Bodie Island Wreck		Mile 3.5
Hill Crest Road Wreck		Foot of Hill Crest Drive
Kitty Hawk Worthington Site		Mile 13.5
6.8 Mile South Poyners Hill Site		Mile 6.8 Poyners Hill
Septic Tank Wreck		N. of East Forest Street Ramp

REPORTED SHIPWRECKS

Wreck Name	Date Lost	Type Vessel	Location
James E. Newsome		Schooner	off Nags Head
Phillipa	1728	Brigantine	Old Roanoke Inlet
Delaware	1741	Ship	2 leagues S. Old Roanoke Inlet
Marget	1773	Ship	off Bodie Island
Chance	1789	Schooner	Bodie Island near Currituck
Patriot	1813	Pilot Boat Privateer	Nags Head

Wreck Name	Date Lost	Type Vessel	Location
Bolina	1816	N/A	on Bodie Island
General Swift	1817	Brig	60 miles N. of Cape Hatteras
Stoughton	1818	Brig	near Three Sand Hills
William Carlton	1818	Ship	north banks of Kill Devil Hills
Peter Francisco	1823	N/A	on Bodie Island
Eliza & Mary	1825	Schooner	on Bodie Island
Enterprise	1825	Schooner	near Roanoke Island
Enterprise	1827	Schooner	Nags Head
Louisa Matilda	1827	N/A	on Bodie Island
Cuba	1828	Brig	1 mile S. of Nags Head
Adams	1829	Brig	Bodie Island
Sarah Ann	1829	Schooner	Kitty Hawk
Mexican	1830	Schooner	Bodie Island
Milly Francis	1830	Schooner	Bodie Island
Perfect	1830	Ship	Bodie Island
Eliza	1831	Brig	Bodie Island
James Madison	1831	Schooner	Bodie Island
Hendrica	1831	Galliot	on Bodie Island
Pearl	1832	Brig	Bodie Island
Hercules	1833	Brig	Bodie Island
Thomas Wyns	1833	Schooner	Bodie Island
Two Brothers	1833	Schooner	Nags Head
Chesapeake	1834	Schooner	on Caffees Inlet
York	1834	Schooner	Nags Head
Belle	1836	Schooner	Bodie Island
Francis Ellen	1836	Schooner	Nags Head
Lydia	1836	Brig	on Bodie Island
Alhambra	1837	Schooner	Bodie Island
Enterprize	1837	Brig	Bodie Island
Merchant	1837	Schooner	on Bodie Island
Victory	1837	Schooner	Bodie Island
Unknown Brig	1838	Brig	30 miles S. Currituck Beach on Kitty Hawk Banks
Franklin	1839	Schooner	on Bodie Island, 2 miles N. of New Inlet
Unknown Schooner	1839	Schooner	at Bodie Island
Edwin	1840	Brig	Bodie Island
Pedestrian	1840	Schooner	20 miles N. of New Inlet
Marion	1842	Brig	Bodie Island
Trident	1842	Schooner	near Bodie Island
Roger Pamely	1843	Schooner	Bodie Island
William Taylor	1843	Brig	on Bodie Island
Danube	1844	Schooner	40 miles S. Cape Henry
McDonough	1844	Schooner	Kitty Hawk, 12 miles N. Nags Head
Moon	1845	Brig	Nags Head
Anthracaphora	1846	Schooner	Nags Head
Baltimore	1846	Schooner	on Nags Head
Chingarora	1846	Schooner	5 miles S. of Nags Head
Columbia	1846	Ship	Bodie Island at Powell Point
Eclipse	1846	Schooner	5 miles S. of Nags Head
E.W. Bradley	1846	Schooner	4 miles S. of Nags Head
Gratitude	1846	Pilot	off Nags Head
Howard	1846	Ship	at Nags Head
Howell (Howard)	1846	Ship	ashore 4-5 miles S. of Nags Head
Letitia	1846	Schooner	ashore 10 miles N. of Nags Head

Wreck Name	Date Lost	Type Vessel	Location
Lewis Spencer	1846	Schooner	ashore on Bodie Island
Mary Morris	1846	Bark	4-5 miles S. of Nags Head
Antilla	1847	Schooner	Nags Head, 65-70 miles S. of Cape Henry
H.W. Sprafford	1847	Schooner	34 miles N. of Cape Hatteras
Josephine	1851	Schooner	at Nags Head
Kingston	1852	Barque	off Nags Head
Mountaineer	1852	General Steamer	20 miles S. of Currituck Inlet
Augustus Moore	1853	Schooner	Kitty Hawk
Aurora S.	1853	Schooner	3 miles N. of Nags Head
Bladen	1853	General Steamer	Kitty Hawk
Rio	1853	Schooner	Bodie Island between Hatteras and Cape Henry
Wilson Fuller	1853	Brig	on Bodie Island
Idlewild	1856	Brig	on Bodie Island
Mary E. Hoover	1856	Schooner	at Bodie Island
Star of Empire	1857	Ship	ashore 25 miles below Currituck Inlet
Atlanta	1858	Merchant Steamer	Bodie Island
George Whitney	1858	Brig	Nags Head
John Castner	1858	Schooner	at Nags Head
Abby Whitman	1859	Schooner	at Bodie Island
Charles	1859	Schooner	Nags Head
Sutton	1860	Brig	Bodie Island
Ocean Express	1861	Ship	Kill Devil Shoals
Vera Cruz	1861	Steamer	Bodie Island, 1 mile N. of Oregon Inlet
Oriental	1862	Iron Screw	Bodie Island, 33 miles N. of Cape Hatteras
Crocus/Solomon Thomas	1863	Tug	on Bodie Island
Alcyone	1866	Ship	on Bodie Island
Sheridan	1866	General Steamer	ashore on Bodie Island
Adamantine	1867	Schooner	Bodie Island
Lizzie Taylor	1867	Schooner	ashore in Nags Head
Ellen P. Rich	1868	Brig	ashore N. of Oregon Inlet
Two Brothers	1868	Ship	Bodie Island
Ezra	1869	Bark	Bodie Island on Outer Shoal
San Jacinto	1869	Steam Barge	ashore on Bodie Island
F.E. Allen	1870	Schooner	on Bodie Island
Unknown Schooner	1871	Schooner	ashore on Bodie Island
Baltic	1872	Bark	Bodie Island
English Bark	1872	Bark	ashore on Bodie Island
Willie	1872	Schooner	Bodie Island
Unknown Schooner	1872	Three-masted Schooner	between Cape Hatteras & False Hope
Ariadne	1873	General	Nags Head
Harriet N. Rogers	1873	Schooner	Bodie Island
Volunteer	1873	Iron Steamer	12 miles N. Bodie Island Light on Kitty Hawk
J. Means	1874	Schooner	outside reef 10 miles N. of Oregon Inlet
Waltham	1874	Brig	5½ miles S. of Bodie Island Light
Ed J. Heraty	1877	Schooner	5 miles N. of Kitty Hawk Beach
Unknown Schooner	1877	Schooner	12 miles N.E. of Kitty Hawk Station
Western Star	1877	Schooner	12 miles N. of Life Saving Station #6
Unknown Small Boat	1877	Boat	1 mile from Kitty Hawk Station
Nipote	1878	Barkentine	3 miles N. of Nags Head Station
Unknown Italian Brig	1878	Brig	north of Oregon Inlet

Wreck Name	Date Lost	Type Vessel	Location
Success	1879	Norwegian Barque	Bodie Island opposite Station #5
Resolute	1881	Steamer	northern side of Oregon Inlet
Angela	1883	Italian Barque	¼ mile S. Station – Paul Gamiel Hills
Annie S. Carll	1883	Schooner	½ mile N. of Nags Head Station
C.W. Lewis	1883	Schooner	6 miles S.E. of Kitty Hawk Station
Luola Murchison	1883	Schooner	abreast of Kitty Hawk Station
Unknown Small Boat	1883	Boat	½ mile N. of Nags Head Station
USS *Huron*	1887	Iron-hulled Steamer	Highway 158 Milepost II Nags Head
Delhi	1887	Schooner	3 miles N. of Kill Devil Hills Station
Edith Linwood	1887	Schooner	Bodie Island Light S. by S.W. 26 miles, N.W. by N. 58 miles
Mary Ann	1888	Sloop	¾ miles from Kitty Hawk Station
Samuel Welsh	1888	Bark	20 miles S.E. of Whales Head Station
Francis E. Waters	1889	Two-masted Schooner	2¾ miles N.N.W., Kill Devil Hills Station
Hattie Lollis	1889	Schooner	1½ miles N.N.W. of Nags Head Station
Leallie	1889	Schooner	ashore near Kitty Hawk
WM H. Bailey	1889	Schooner	N/A
Unknown Schooner	1889	Schooner	at Nags Head
Dudley Farlin	1890	Schooner	24 miles N.E. of Bodie Island Light
Hudson	1891	General Steamer	Bodie Island Beach, 3 miles S.S.E. Nags Head Station
Sirene	1892	Yacht	off Nags Head
Anna	1893	Bark	8 miles W., ½ mile S. of Cape Lookout Station
Delphine	1893	Fish Boat	2 miles N. of Oregon Inlet Station
Emma J. Warrington	1893	Two-masted Schooner	½ mile S. of Paul Gamiels Hills Station
Peter H. Crowell	1893	Schooner	13 miles off Bodie Island
Scow #9	1893	Scow	1 mile S.S.E. of Paul Gamiels Hill Station
Unknown Vessel	1893	N/A	2 miles E.S.E. of Bodie Island Light
Florence C. Magee	1894	N/A	off Bodie Island Light
Florence C. McGee	1894	Four-masted Schooner	¾ m. N. of Bodie Island Station, 600 yds offshore.
Frisky	1894	Fish Boat	2 miles N. of Oregon Inlet Station
New Light	1894	Bark	on Bogue Beach
Frances Ann	1894	Sloop	200 yards N. of Oregon Inlet
I.J. Merritt	1895	Steamer	2 miles S.S.E. of Kill Devil Hills Station
Laura Nelson	1895	Schooner	2½ miles from Bodie Island Station
Manati	1895	Steamer	2½ miles S.S.E. of Kill Devil Hills Station
Trinidad	1895	Barge	¾ mile N.N.W. of Kill Devil Hills Station
William Frederick	1895	Schooner	off Bodie Island
Unknown Steamer	1895	Steamer	near Bodie Island
Mary Caroline	1895	Sailboat	1/8 mile N. of Oregon Inlet Station
Rosette	1895	Sailboat	1/6 mile N. of Oregon Inlet Station
Frederick Debarry	1896	Passenger Steamer	2½ miles N. Kitty Hawk Life Saving Station
George M. Adams	1897	Schooner	1 mile S.S.E. Nags Head Station, 75yards from shore
Matilda	1897	Ship	2½ miles N. of Bodie Island Station
Milton	1898	Schooner	Bodie Island
June	1899	Sloop	1½ mile N. of Oregon Inlet Station
Unknown Boat	1899	Skiff	¼ mile E. Paul Gamiels Hill Station

Wreck Name	Date Lost	Type Vessel	Location
Jane C. Harris	1900	Schooner	2 miles N. of Oregon Inlet Station
Honiton	1900	Steamer	2¼ mile S.E. Paul Gamiels Hill Station
Unknown Boat	1901	Fish Boat	½ mile E.N.E. of Bodie Island Station
Unknown Boat	1901	Fish Boat	½ mile N. of Kitty Hawk Station
J.F. Becker	1903	Schooner	2½ miles N. Paul Gamiels Hill Station
William H. Shubert	1903	Three-masted Schooner	2 miles N. of Bodie Island Station
Belle	1904	Sloop	5 miles W.N.W. of Nags Head Station
Aragon	1905	Screw	17 miles N. of Bodie Island
Goddard	1905	Barge	ashore between Nags Head and Kill Devil Hills
Lou Willis	1905	Schooner	2 miles S.W. of Paul Gamiels Hill Station
Thomas A. Goddard	1905	Three-masted Schooner	Nags Head
Unknown Barge	1905	Barge	N. of Kill Devil Hills Station
Mary I. Wroldson	1906	Sloop	5 miles W. of Kitty Hawk Station
Brant	1907	Schooner	1 mile S.W. of Nags Head Station
Bossert	1907	Schooner	S. of Kill Devil Hills
Charles S. Hirsch	1908	Schooner	1¼ m. S.S.E. Paul Gamiels Hill Station, 100 yds offshore
Flora Rogers	1908	Three-masted Schooner	1 mile N. of Bodie Island
Florence Shay	1908	Schooner	Bodie Island
William H. Davidson	1910	Schooner	1½ miles S. Paul Gamiels Hill Station, 150 miles offshore
Elizabeth	1911	Gas Steamer	1½ miles S. of Nags Head Station
Montrose W. Houck	1913	Schooner	650 yards E. of Paul Gamiels Hill Station
Helen H. Benedict	1914	Three-masted Schooner	2½ miles S.S.E. of Nags Head Station
Frank E. Swain	1915	Schooner	off Bodie Island
The Josephine	1915	Schooner	1¾ miles S.E. Kill Devil Hills Station, 150 yards offshore
A.A. Raven	1917	Screw	on reef off Bodie Island
Hattie Gage	1918	Screw	2 miles S. of Nags Head Station
Explorer	1919	Seagoing Tug	N. of Nags Head Pier – 200 yards offshore
M.B. Davis	1920	Schooner	2¾ miles E. of Bogue Inlet Station
Laura A. Barnes	1921	Four-masted Schooner	1 mile N. of Bodie Island Station
R.R.Govin	1924	Schooner	14 miles off Bodie Island
Irma	1925	Schooner	1 mile N. of Kill Devil Hills Station
Kyzickes (Paraguay) Site	1927	Tanker Steamer	Mile Marker 7, Kill Devil Hills
Carl Gerhard Site	1929	N/A	Mile Marker 7, Kill Devil Hills
Bainbridge	1929	Schooner	Nags Head, 6 miles N. of Bodie Island Station
Carl Gerhard	1929	Swedish Steamer	1 mile N. of Kill Devil Hills
St. Rita	1932	Trawler	1 mile S. of Paul Gamiels Hill Station
Glory	1933	Steam Freighter	Nags Head
Drinkwater	1939	Gunboat	Manteo ?
Oriental	1969	Fishing Trawler	1 mile N. of Bodie Island Light
Unknown Vessel	1987	Landing Craft	35,54'01" N. by 75,23'48" W.
Unknown Barge	1989	Barge	Artificial Reef #140
Unknown Barge	1989	Barge	8.9 miles off Oregon Inlet Sea Buoy
Advance II	1995	Screw	Loran reading: 26941.2/ 40685.3

Beach Reconnaissance: 1997

No exposed shipwrecks were identified on the beach between Oregon Inlet and Kitty Hawk. Several disassociated and isolated wooden fragments of shipwrecks were identified mixed with other flotsam along the high-tide line. However, no articulate structural remains were found within the proposed beach re-nourishment area.[4]

Remote Sensing Survey: 1997

BORROW AREA E

No magnetic or acoustic targets were identified in Borrow Area E (Figure 2).

BORROW AREA C

Target C1: NC State Plane Coordinates: N=859,667 E=2,986,688

Target C1 had a dipolar magnetic signature of 62 gammas at maximum intensity (Appendix A). The object or material creating the magnetic anomaly influenced an area over 6 one-second sample intervals. The characteristics of the magnetic signature suggest that the object creating the anomaly is a single object of high ferrous mass relative to size. No acoustic signature corresponded to the magnetic anomaly. Heavy iron or steel anchors, pipe, or even historic cannon with a mass of less than 1 ton can create such an anomaly. Single isolated objects of modern or historic origin seldom have the potential to meet the criteria for nomination to the National Register of Historic Places. No additional investigations or mitigation is recommended (Figure 2).

Target C2: N C State Plane Coordinates: N=855,249 E=2,986,421

Target C2 had a dipolar magnetic signature of 49 gammas at maximum intensity (Appendix A). The object or material creating the magnetic anomaly influenced an area over 7 one-second sample intervals. The relatively high intensity and short duration of the magnetic signature suggest a small, high-mass object. No acoustic signature corresponded to

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[4] Three shipwreck sites were reported to M-AT/ER archaeologists by city lifeguards: 1.) The well-known wreck of the *Huron*, off the foot of Bladen Street, Nags Head; 2.) Unknown wreck offshore at the foot of Eckner Street in Kitty Hawk; 3.) Unknown wreck offshore in the vicinity of the Bath House, Kitty Hawk.

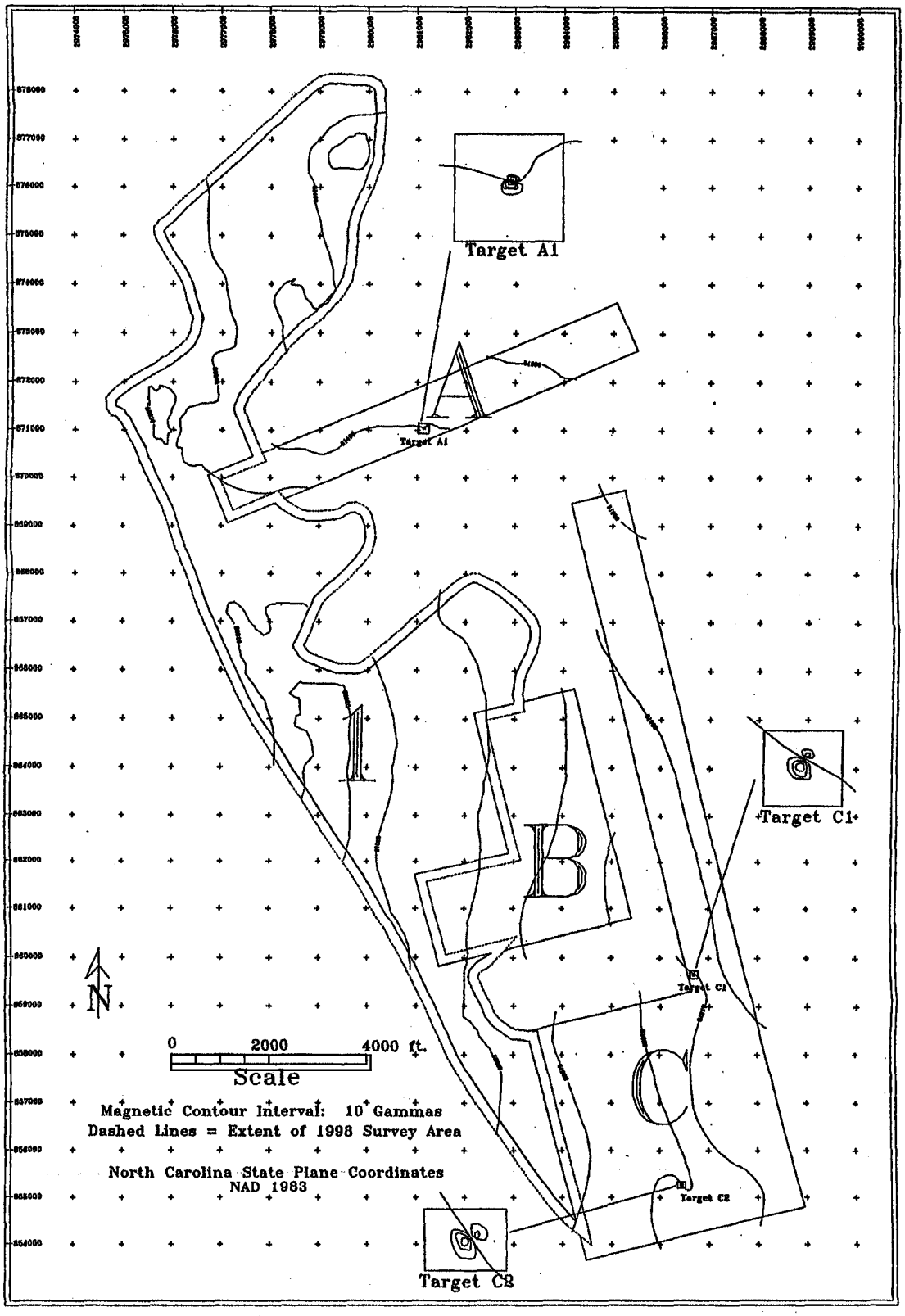

Figure 2. Magnetic Contour / Target Location Map: Areas A, B, C, and 1.

the magnetic anomaly. Iron or steel anchors, pipe, or even historic cannon with a mass of less than ½ ton can create such an anomaly. Single isolated objects of modern or historic origin seldom have the potential to meet the criteria for nomination to the National Register of Historic Places. No additional investigations or mitigation is recommended (Figure 2).

BORROW AREA B

No magnetic or acoustic targets were identified in Borrow Area B (Figure 2).

BORROW AREA A

Target A1: N C State Plane Coordinates: N=871,034 E=2,981,065

Target A1 had a dipolar magnetic signature of 77 gammas at maximum intensity (Appendix A). The object or material creating the magnetic anomaly influenced an area over 4 one-second sample intervals. The relatively high intensity and short duration of the magnetic signature suggest a small, high-mass object. No acoustic signature corresponded to the magnetic anomaly. Iron or steel anchors, pipe, or even historic cannon with a mass of less than ½ ton can create such an anomaly. Single objects of modern or historic origin seldom have the potential to meet the criteria for nomination to the National Register of Historic Places. No additional investigations or mitigation is recommended (Figure 2).

Beach Reconnaissance: 1998

No exposed shipwrecks were identified on the beach between Oregon Inlet and Kitty Hawk during the 1998 reconnaissance.

Remote Sensing Survey 1998

BORROW AREA 1

No magnetic or acoustic targets were identified in Borrow Area 1 (Figure 2).

BORROW AREA 2

No magnetic or acoustic targets were identified in Borrow Area 2 (Figure 3).

BORROW AREA 3

No magnetic or acoustic targets were identified in Borrow Area 3 (Figure 3).

BORROW AREA 4

No magnetic or acoustic targets were identified in Borrow Area 4 (Figure 3).

RECOMMENDATIONS

The remote sensing survey identified three (3) single-source magnetic anomalies within the proposed borrow areas. No acoustic targets were identified. Because a significant number of vessels have been lost near the inlet, all of the magnetic anomalies have the potential to be associated with a historic shipwreck. However, single isolated objects of modern or historic origin seldom have the potential to meet the criteria for nomination to the National Register of Historic Places. Whereas all the anomalies identified by this investigation were single-source anomalies, no additional cultural resource investigations or restrictive actions are recommended.

During the 1997 and 1998 field season, no archaeological sites were observed on the beach within the proposed nourishment area. Near shore or beach wrecks are most frequently exposed during winter months or following storms. Because exposure of potential wrecks sites in the vicinity of the proposed beach re-nourishment project is a transient phenomenon, the North Carolina Department of Cultural Resources has recommended that additional investigations take place within a few months of project construction. These investigations will likely be conducted by State and U.S. Army Corps of Engineers Staff, or will be conducted under their supervision.

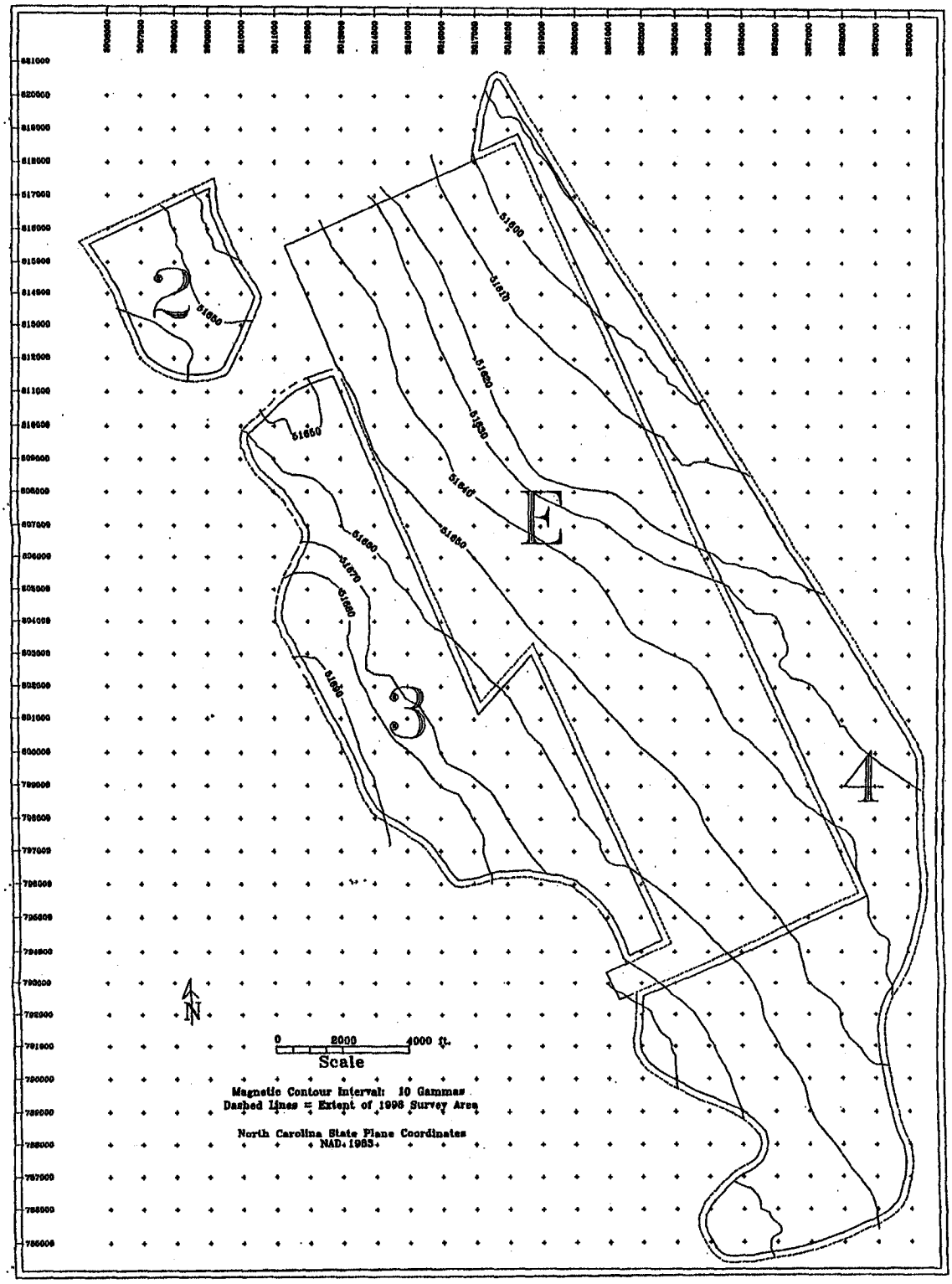

Figure 3. Magnetic Contour / Target Location Map: Areas 2, 3, 4, and E.

APPENDIX A: MAGNETIC TARGET SIGNATURES

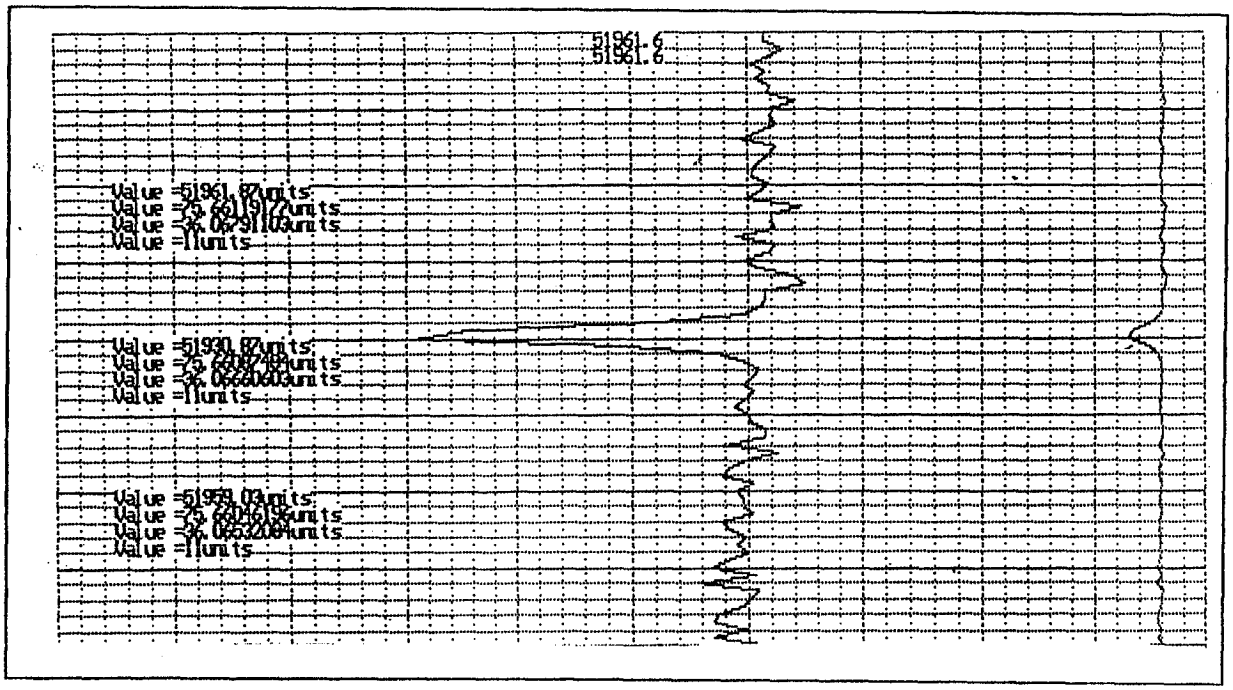

Figure 4. Magnetic Target Signature C1 / General Survey.

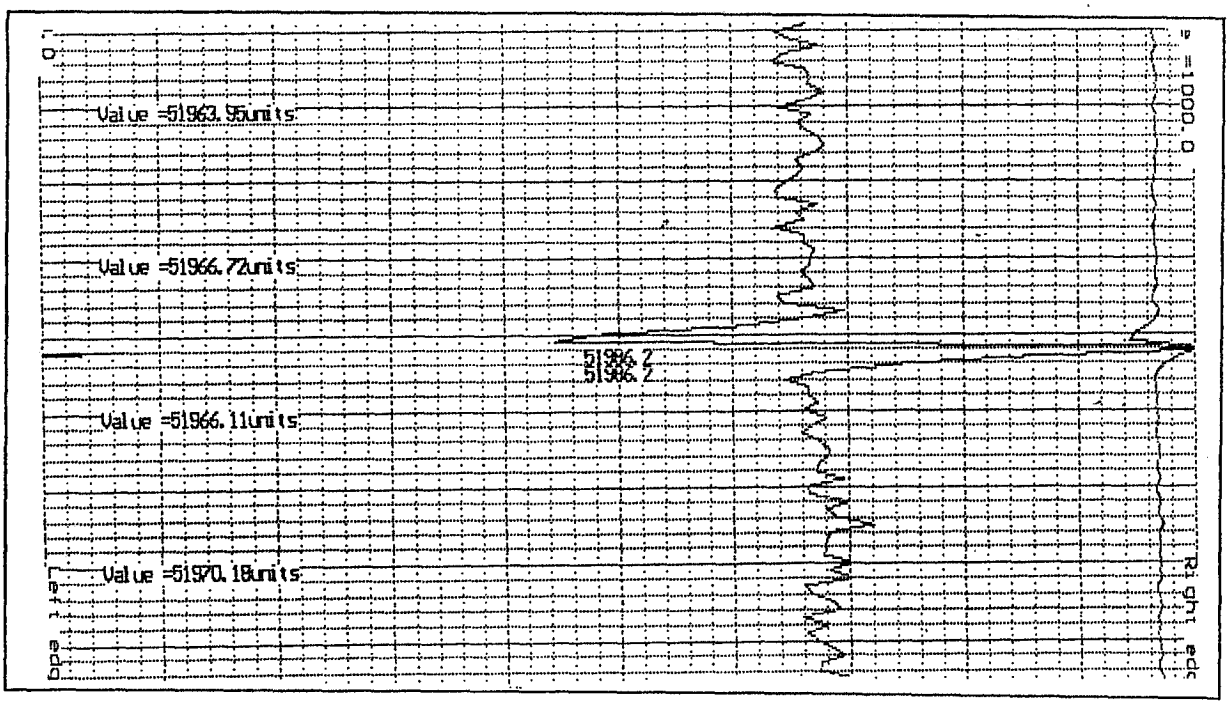

Figure 5. Magnetic Target Signature C1 / Relocation Survey.

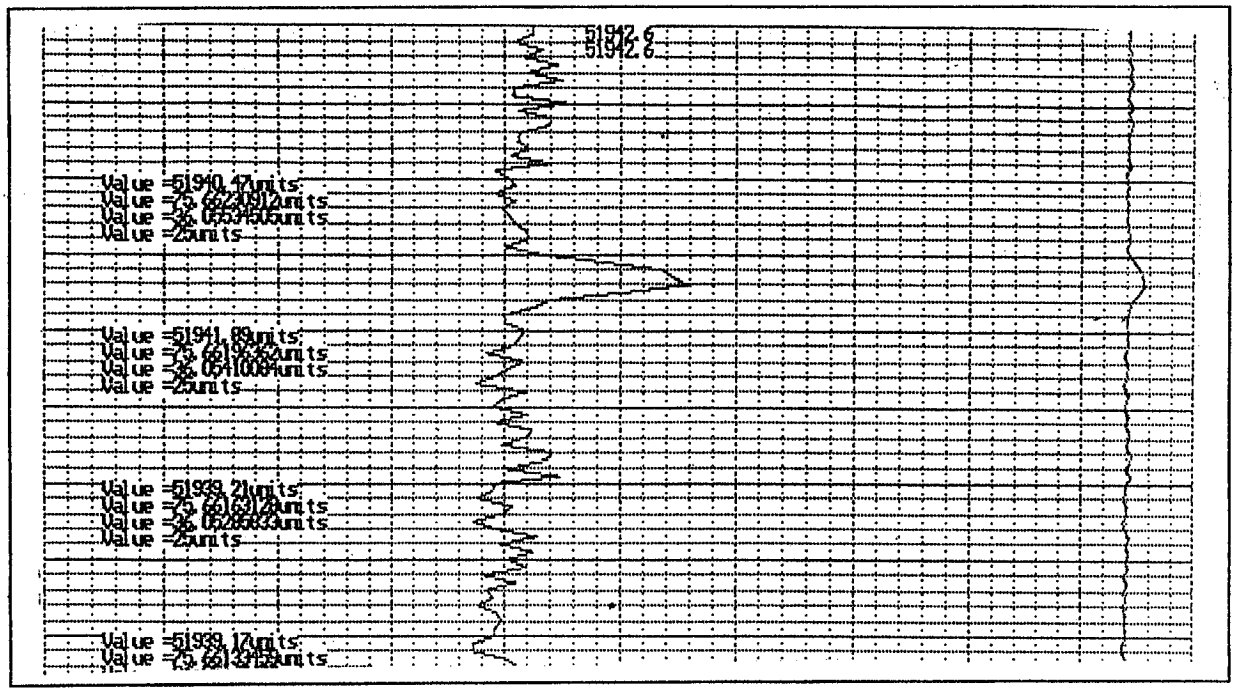

Figure 6. Magnetic Target Signature C2 / General Survey.

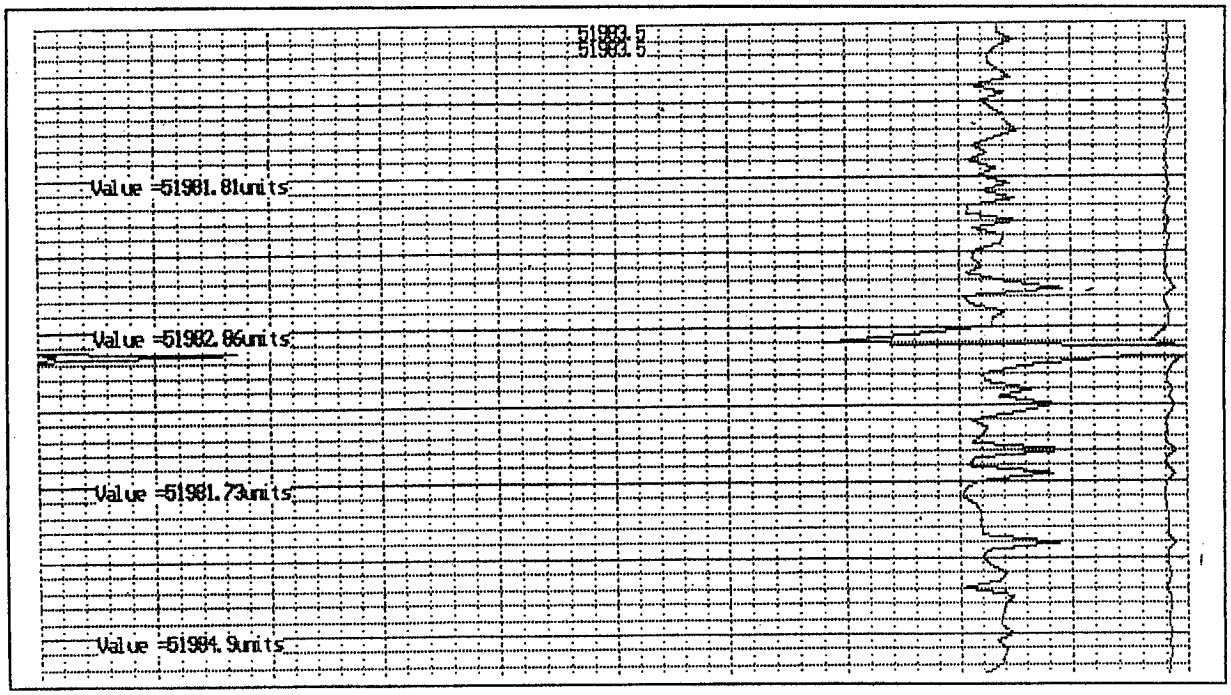

Figure 7. Magnetic Target Signature C2 / Relocation Survey.

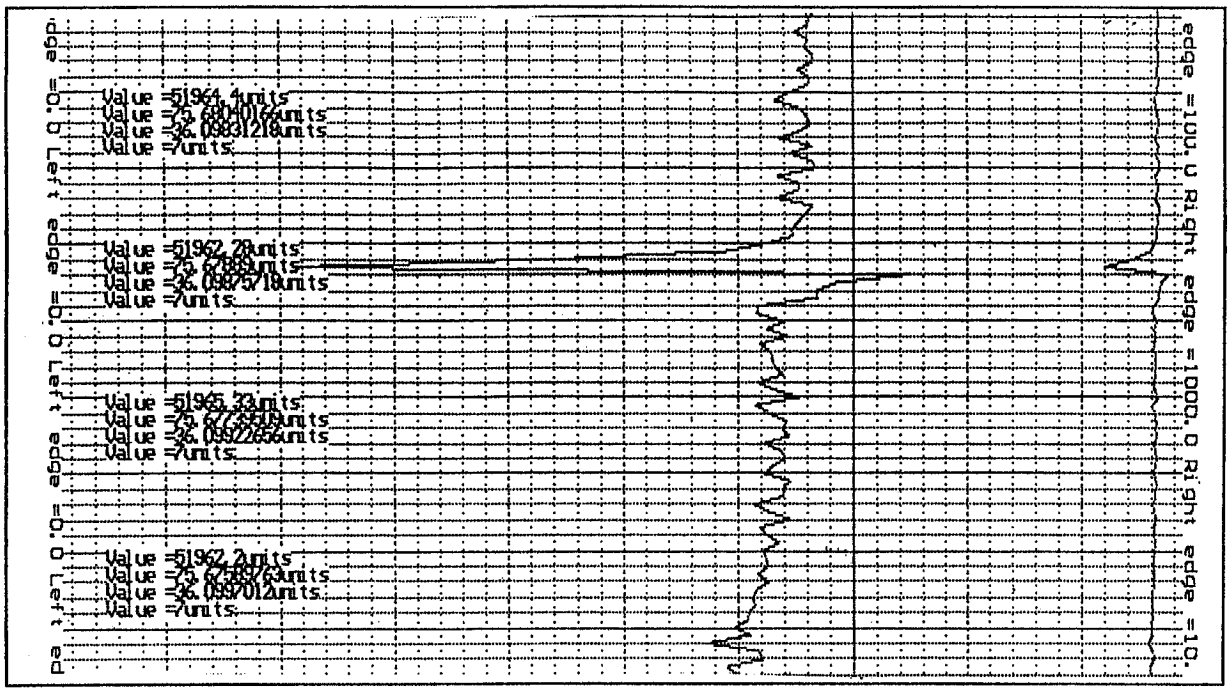

Figure 8. Magnetic Target Signature A1 / General Survey.

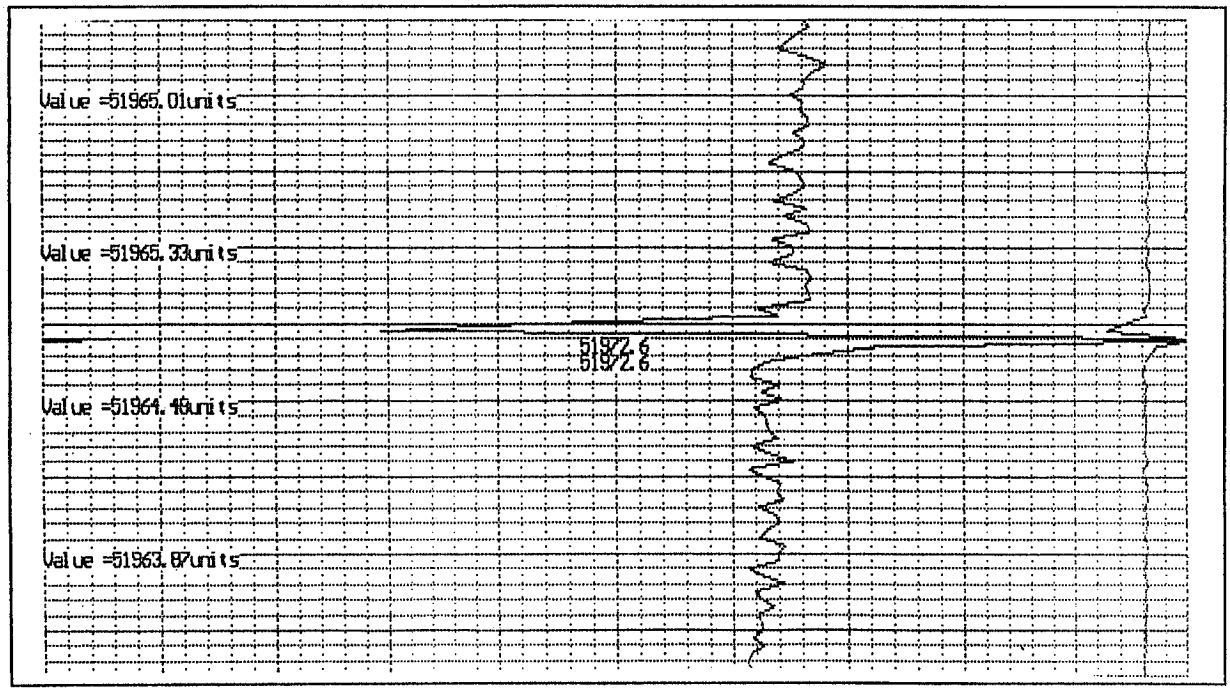

Figure 9. Magnetic Target Signature A1 / Relocation Survey.

APPENDIX B:

ANALYSIS OF SIDE-SCAN SONAR RECORDS TO DESCRIBE BOTTOM TYPE WITHIN BORROW AREAS A, B, C, E AND 1, 2, 3, 4

Analysis of Sonogram Records to Describe Bottom Type within Borrow Areas A, B, C, E and 1, 2, 3, 4

As part of the remote sensing survey for submerged cultural resources, investigators also reviewed side-scan sonar and hydrographic data to identify "hard bottom" that may support significant habitat for marine animals. A 500 kHz Klein System 2000 dual-frequency, digital, side-scan sonar and an Odom Hydrographics System Echotrac DF3200MKII depth recorder were used to conduct the remote sensing survey of Areas E, C, B, and A, in 1997. Each instrument was interfaced with a NAVSTAR™ Differential Global Positioning System. Acoustic data, with corresponding positioning data, was recorded continuously on paper and/or 8mm data tapes. The side-scan sonar was maintained at an altitude above the bottom (generally 20 to 30 feet), thereby providing the most detailed records. Hydrographic data was recorded entirely in HYPACK™ hydrographic survey and navigation software. Data was collected along parallel lines spaced at 100-foot intervals throughout each borrow area.

During the 1998 remote sensing survey, the following devises were used: 1) a Geometrics 881 cesium marine magnetometer; 2) a DF-1000 EdgeTech digital, dual-frequency (100-500 kHz) side-scan sonar with a 560D Processor; and 3) a JRC precision depth recorder was used to conduct the bottom survey. The same methods and line spacing utilized in 1997 were used in the 1998 survey.

No hard bottom or live bottom areas were identified within the expanded borrow areas. The entire bottom in each borrow area was identified as either soft migrating sand or compact sand. In general, deeper bottom was characterized by migrating sand shown on sonogram records as large sand waves, while shallow bottom generally was characterized by more compact sand shown as indistinct or small sand waves. Transition from compact to migrating sand generally corresponded to changes in depth. *See* Figures 4 and 5 for bottom surface maps of project areas.

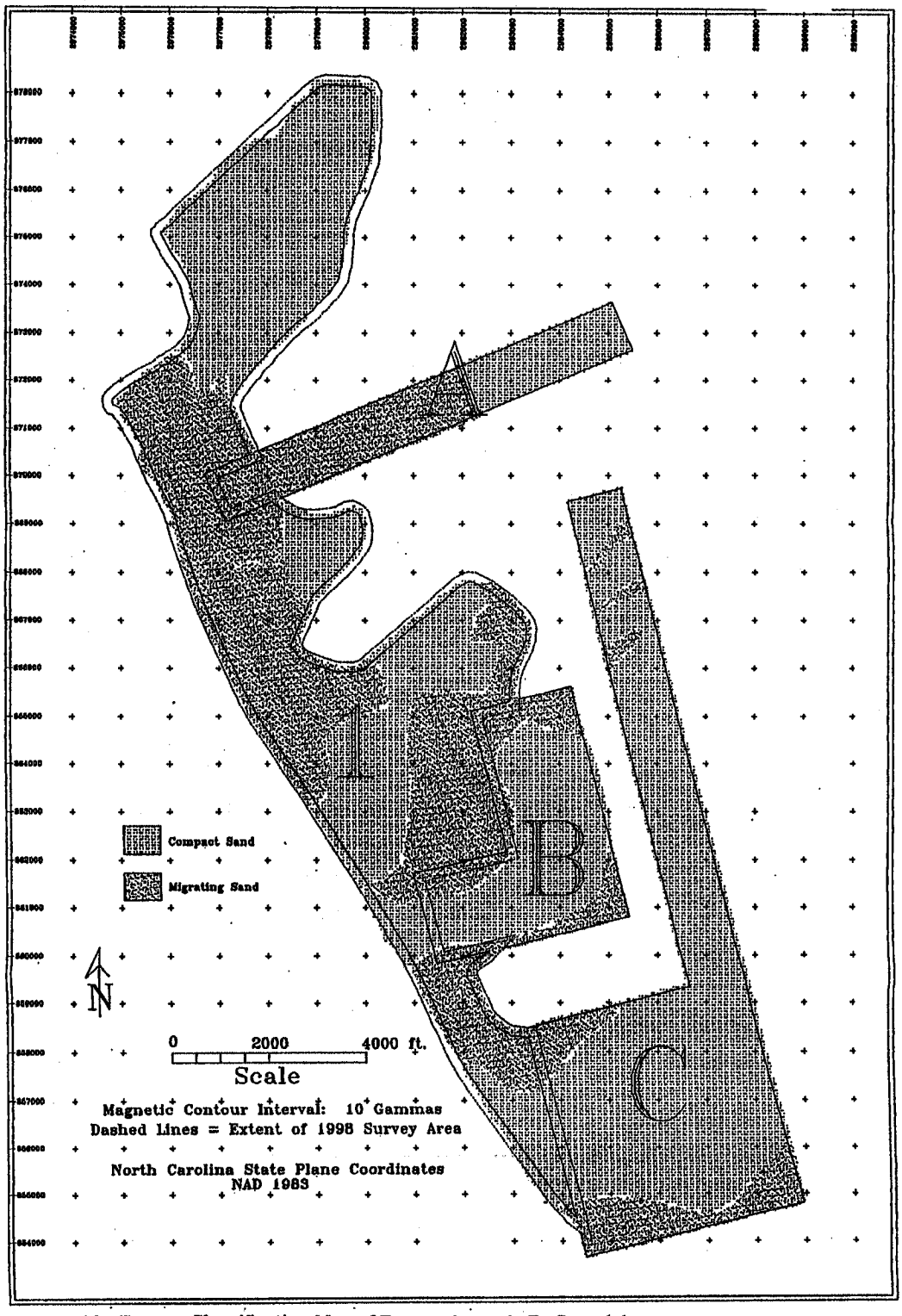

Figure 10. Bottom Classification Map of Borrow Areas A, B, C, and 1.

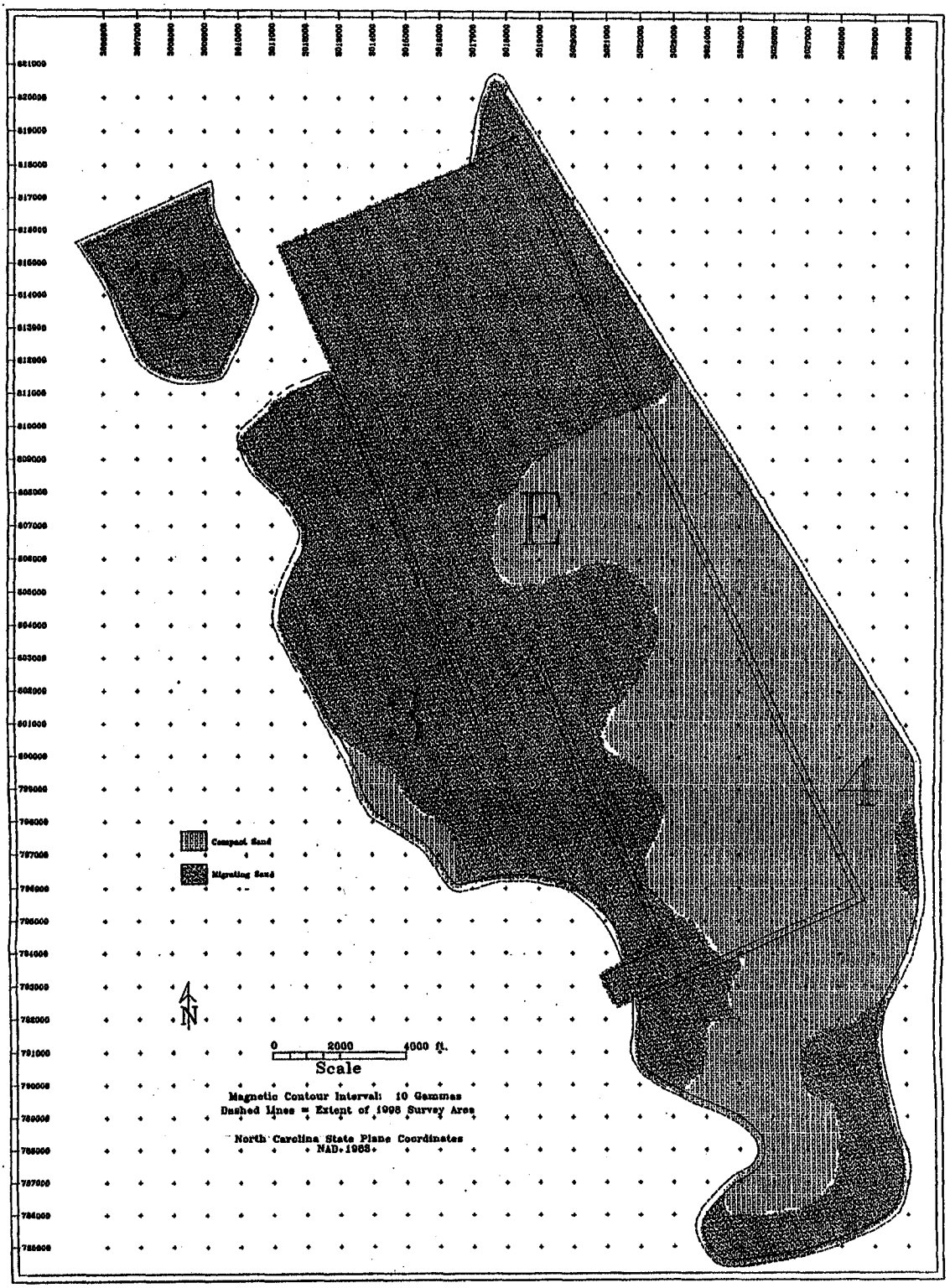

Figure 11. Bottom Classification Map of Borrow Areas 2, 3, 4, and E.